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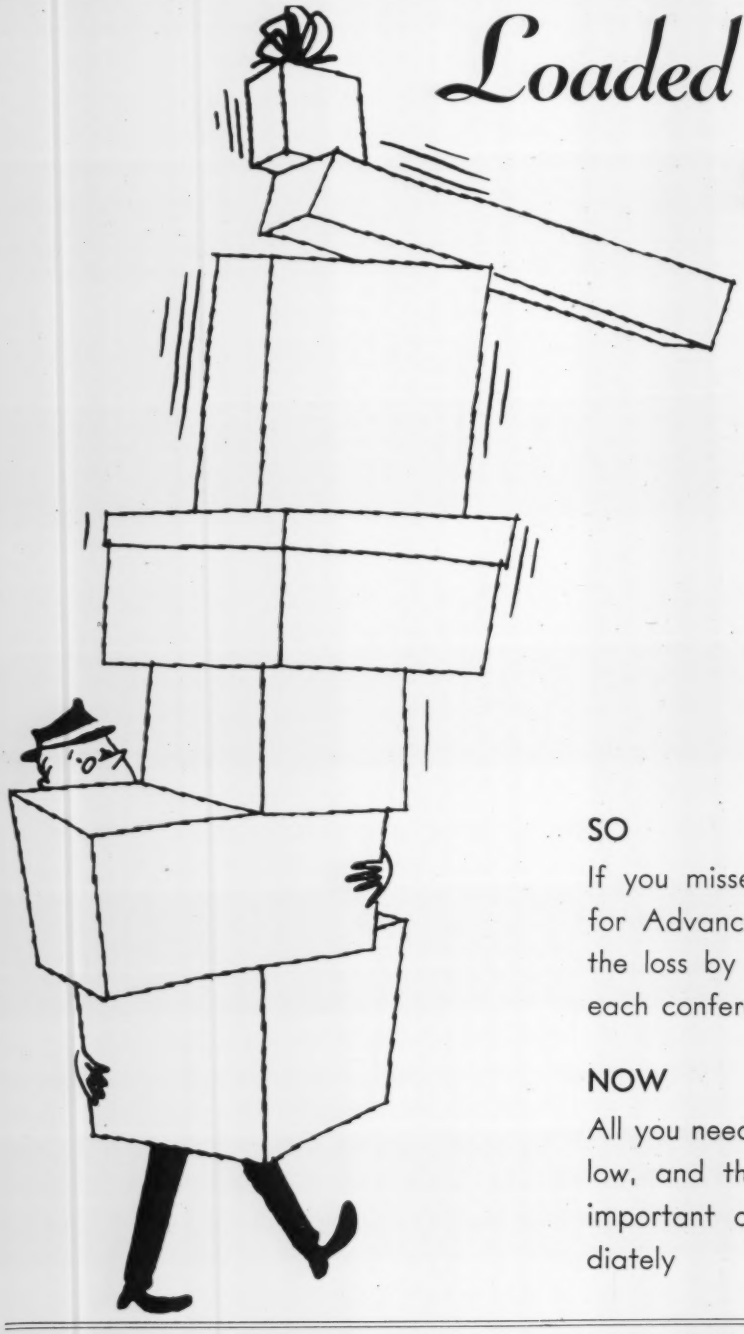

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"Through research, discussion, publication, and other appropriate means to conduct and promote scientific study of the principles governing organized effort in industrial and economic life . . . for the general betterment of society . . ."

S.A.M. Constitution

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Self-Development

TOP management has reached the conclusion that there is a shortage of capable executives and that the growth of our economy will cause this shortage to be more acute. Such a situation offers an unlimited future to those who open the door to opportunity's knock.

This is the time for each of us to take the initiative and start our own Executive Development Program to supplement any formal training our companies offer.

If we are fortunate enough to be working where there is a formal employee appraisal plan in effect, our work will be analyzed objectively and we should be receiving guidance in our self-development efforts.

For those without the assistance of a formal appraisal program, the following questions may be of some assistance in highlighting possible areas of development.

I. In Becoming a "Top Notch" Employee, to What Degree

- Am I growing in emotional maturity and stability?
- Am I sensitive to the feelings of others?
- Do I show work interest? Drive? Staying power?
- Does my work show initiative, resourcefulness, inventivenesss, originality, innovation, imagination?
- Do I seek to improve my technical competence?
- Do I set high standards of work performance for myself?
- Do I take active measures to profit by my mistakes?

II. In Striving to Become a Good Leader, to What Degree do I

- Set the example of an outstanding job performance on my present job?
- Inspire confidence, loyalty, and acceptance in others?
- Teach, coach, and guide the development of my people?
- Organize, build, and maintain an effective group activity?
- Become a "rallying point" in times of stress and crisis?
- Motivate and stimulate men to do their best?

III. In Learning to Become a Good Manager, to What Extent Can I be Counted on to

- Set and reach objectives and goals through other people?
- Plan and organize my work and that of my group?
- Integrate the activities, personalities, and resources of my group into a dynamic, unified, productive team?
- Measure and evaluate results?

IV. In Applying the Knowledge and Skills of Management, to What Extend do I

- Have a growing understanding of the business of the Company in relation to the industry and the economy as a whole?
- Have a broad working knowledge of the Company's objectives, policies,
- systems, management tools, and programs?
- Have the habit of striving for continuing growth, reaching for and utilizing available Company resources for self development?

As each of us looks at himself in terms of these abilities, qualities and skills, it is a "sight setting" and stimulating experience which can be of great value in planning and working toward our continuing growth.

These questions cannot only be a guide to self appraisal and self development but they can also be used to find, select, and promote men who have earned the right for these considerations.

John B. Joynt
National President

From 1943 to 1945 Mr. Stringfield headed the E. I. duPont de Nemours & Co., Ltd., University of Chicago Operations Accounting Department. He went to Monsanto Chemical Company, in 1945, to head the Accounting Department of that firm's Oak Ridge plant, and in 1948 he joined Union Carbide Nuclear Company in his present position. Mr. Stringfield is a member of the Society for Advancement of Management, has served as the Knoxville Chapter's president and is currently the national director of that chapter.

HEZZ STRINGFIELD

Nuclear Energy Opportunities In The South

by Hezz Stringfield

Executive Assistant to Plant Director
In Charge of Fiscal Affairs
Union Carbide Nuclear Company
Oak Ridge, Tennessee

An address given before the Alabama Chapter of the Society for Advancement of Management on November 13, 1956.

FORTUNATELY the challenges of nuclear energy are so clear, and many of the opportunities it affords are so logical in their outgrowth from technological developments over the past ten years, that one does not have to be a nuclear scientist to understand and talk about the broader aspects.

It is easy to see that there is a great deal of optimism throughout the country, and in fact throughout the world, concerning the opportunities afforded by nuclear energy.

For the benefit of some of you who may have been too busy to keep posted on nuclear energy developments, I would like to give a few basic facts that help to make nuclear energy make sense. Perhaps the most basic fact is that nuclear energy has its source in the nucleus of the atom. This may seem so simple and obvious as not to be worth mentioning, but it is important. All of the energy available to mankind until 1942 came from *atoms*, it's true. But it did not come from the *nucleus* of the atom, it came instead from the electrons which surround the nucleus. When a fire burns and carbon unites with oxygen to form carbon dioxide and to liberate heat and light, only the electrons are involved. The nuclei of the atoms are not affected at all.

Now let's come back to *nuclear* energy. The only way that energy can be released from the *nucleus* of an atom is through *radiation*. This is very important because it explains why the hazards of radiation must always be associated with nuclear energy. Energy in the form of radiation from the nucleus of an atom is converted into heat when the radiation is absorbed by some material. The material absorbing the radiation gets hot. If the radiation is intense, the material may get very hot and this heat from nuclear energy can be converted into electric power. So far, this is the only way we know in which it can be done. No successful method has yet been developed for the direct large-scale conversion of energy in the form of radiation to useful power. We must go through the intermediate step of converting it to heat.

Somehow, despite all the talk about nuclear energy, the average man seems to feel that nuclear energy opportunities are like the proverbial 'pie in the sky'—someday, maybe, we will get a slice. But that is not really the case, nuclear energy opportunities are available *today* for those who wish to take advantage of them. Many organizations are already taking advantage of them—and, I might add, the number is growing rapidly.

For example, let us consider Union Carbide, the parent corporation under whose direction the Oak Ridge National Laboratory is operated for the Atomic Energy Commission. The U. S. Vanadium subsidiary of Union Carbide has been mining and processing uranium ores in the West for some years. Originally these ores were mined for the vanadium they contained, as you might guess from the name of the company. But now *uranium*, formerly a by-product, is a major product.

In August 1955, Union Carbide formed a new company, the Union Carbide Nuclear Company, which included the former U. S. Vanadium plus the atomic energy plants operated for the AEC by Carbide in Oak Ridge and Paducah, Kentucky. Almost immediately after the formation of the new nuclear company, plans were made and development work started to take advantage of present opportunities in the nuclear energy fields. In particular, Union Carbide Nuclear Company is planning to build a nuclear reactor for research and development and to go into the business of processing reactor fuel after it is removed from nuclear power plants. The company expects to obtain revenue by charging the power plant for reprocessing its fuel and by selling the radioactive fission products that are removed from the fuel in the course of chemical processing.

How can one plan for his own organization to take advantage of the opportunities for realizing profits from nuclear energy? Nuclear energy is so new and so different that many companies don't know how to find the opportunities it affords, much less take advantage of them.

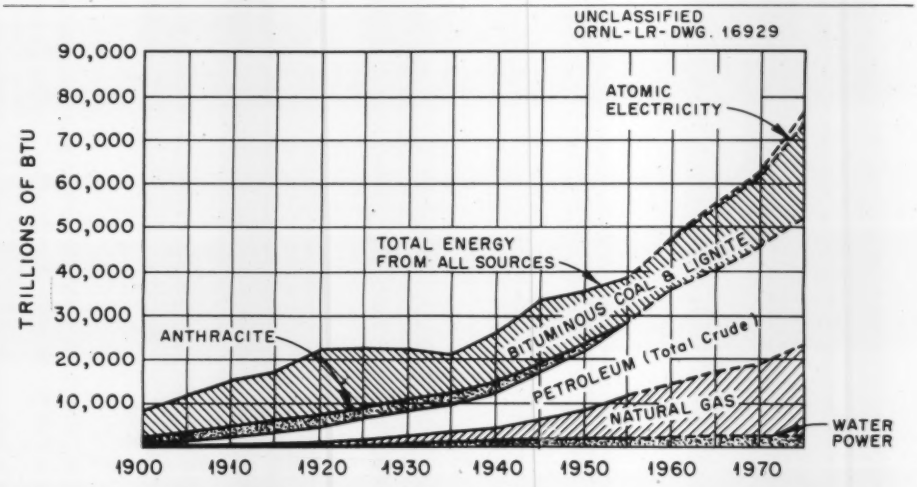
This is a recognized difficulty, and those of us who have been involved with nuclear energy for some fifteen years now are doing all we can to accelerate the education and training of additional personnel in the fields of nuclear energy. In this regard, the South is in a favored position by virtue of having its own nuclear energy center in Oak Ridge, Tennessee. At the Oak Ridge National Laboratory are outstanding scientists working in all fields of nuclear energy research. Opportunities to work with, and learn from, these nuclear energy experts are available now. It is possible for universities and industrial organizations to send their employees to ORNL for practical experience and training.

Through the Oak Ridge Institute of Nuclear Studies, which is a cooperative organization sponsored by 39 Southern universities, additional special training and educational programs are offered.

University faculty members trained in Oak Ridge have made considerable progress toward setting up nuclear science and technology educational programs in their colleges and universities. The list of colleges and universities offering undergraduate and gradute degrees in various fields of nuclear science and technology grows almost daily.

BUT BEFORE we get too worried about nuclear energy education, perhaps we should ask, "Why are we interested in nuclear energy anyway?"

Statisticians tell us that the world utilization of energy is increasing at an unbelievably fast pace. As an illustration, it is estimated that in the twentieth century we will consume more fuel — use more energy—than was used up to the year 1900 from the earliest days of man. Figure 1 shows just how rapid the increase has been since 1900. We note that petroleum and natural gas have provided most of the additional energy to meet increasing demands. The energy that is being burned up at the presently rapid increasing rate comes from reserves that took millions of years to accumulate. It is quite obvious that some day we will have burned all the coal, gas and oil we can get our hands on. Some day much sooner we will have burned all the fossil fuels that can be obtained at cost not too much greater than present day cost. And after that, fuel will cost much more than it does now.



ENERGY SUPPLIED BY MINERAL FUELS, WATER POWER, AND ATOMIC ELECTRICITY IN THE UNITED STATES, 1900-1980.

FIG. 1

Now let's bring the economists into the act. They tell us that by 1975, the electric power demand in the United States may be about 1400 billion kilowatt hours, an increase of some 900 billion kilowatt hours from present levels. In March 1955, the United States electric utility companies produced over 10 billion kilowatt hours of electricity in one week for the first time. So from this one can assume that our present installed electric power generating capacity is capable of producing somewhere in the neighborhood of 500 billion kilowatt hours per year. To increase this capacity by the amount necessary to provide an additional 900 billion kilowatt hours, we will have to construct new power plants with a total installed capacity of something like 300 million kilowatts. And this must be done before 1975.

If we are to build power plants with an installed capacity of somewhere in the neighborhood of 300 million kilowatts in the next 20 years, what *kind* of plants should we build?

Aside from the rapid depletion of the reserves of conventional fuels, one who is planning soundly for the long-range future should be concerned with making the best use of his raw materials. Dr. Curme, who recently retired as Vice President of Union Carbide, has suggested that coal, gas and oil should not be *burned* but should be saved for raw material in the manufacture of synthetic organic chemicals. It is interesting to note that Carbide is doing extensive work on the hydrogenation of coal to make organic chemicals and that Carbide also has production plants already in operation for the direct conversion of natural gas into plastics.

It is quite obvious that American industry, being as competitive and cost conscious as it is, will not suddenly switch over to using nuclear power just for the sake of doing so or even to save the coal, gas and oil for chemical uses. The electricity produced from nuclear fuels has no unique characteristics. Consequently the planner with his feet on the ground will have to assume that nuclear power is of no particular interest unless "the price is right".

So maybe we should turn our attention for a few moments to seeing what is required for the price to be right. If we look at the large electric power plants that have been built in the last 10 years, we find that 20 percent of them produce electric power at a cost of 5 mills per kilowatt hour or less, 50 percent of them produce power for 6 mills or less and 85 percent produce power for 7 mills or less, as shown in Figure 2. Let us assume that since these plants were built all over the country and were designed for all the various types of fuels, the ratio of power costs can be applied with reasonable accuracy to the power plants that will be built in the next 20 years. Probably the biggest variable determining the cost of electric power produced by these plants was the fuel costs. The plants that were built out in Texas or at some place where they could be located almost on top of a natural gas well probably had very low power costs. Plants built at locations where fuel had to be transported long distances probably had the highest power costs. Some of these costs were

as high as 8 and 9 mills per kilowatt hour.

The conventional power plants with which nuclear power plants can compete most successfully are those producing the 15 percent of our electric power that costs more than 7 mills per kilowatt hour. This means that if we can develop nuclear power plants that will produce power for 7 mills per kilowatt hour, we can expect that in the next 20 years there may be a demand for a total installed capacity of some 45 million kilowatts in nuclear power plants.

So it appears that in the United States as a whole, there is a real opportunity for nuclear power to make a significant contribution to our economy in the next 20 years. Since we are assuming that, to start with at least, nuclear power will compete only with those conventional power plants whose electric power costs are highest, it may very well be that a major role of nuclear power will be in relieving the pressure on conventional fuels and in keeping power costs down. If nuclear power keeps the average cost of electric power down by only one-half a mill per kilowatt hour in 1975, the saving to the nation will be over three-quarters of a billion dollars per year. This would amortize the entire cost of research and development on nuclear power in less than a year.

Now we have in effect set a goal for ourselves — to get the cost of nuclear power down to 7 mills per kilowatt hour and to construct something like 45 million kilowatts of installed capacity in nuclear power plants by 1975.

Perhaps it would be appropriate at this point to spend a few minutes considering the progress that has been made to date in working toward this goal. At the Oak Ridge National Laboratory we have been devoting a great deal of effort to the development of improved nuclear reactors for something like ten years now. Immediately after the end of the war our reactor development work was accelerated, and by 1949 we had essentially completed work on the design of what was, at that time, the most advanced reactor in the world. This reactor was constructed by the Atomic Energy Commission at its National Reactor Testing Station near Arco, Idaho. The Material Testing Reactor, as it was called, was the first really new type of reactor to be constructed after the wartime plutonium production reactors. Its performance was so outstanding that it has served as a prototype for many other reactors that have been constructed since. For example, the so-called swimming pool reactors that are so popular for research use these days are but simplified versions of the basic Materials Testing Reactor design. Similarly, the nuclear power plant installed in the Atomic Submarine, Nautilus, is a modification of the basic MTR design and so is the first full scale nuclear power plant now being constructed at Shippingport, Pennsylvania.

Intensive reactor development activities are underway at other AEC installations and also among a steadily growing number of private firms.

In addition to the electric power plant reactors it may be of interest to note the military power reactor progress. We already have one nuclear powered submarine, the Nautilus, in operation and another, the Seawolf, nearing completion. Seven more have been started. In addition, plans have been made for construction of an Army Package Power Reactor at a base in Alaska, and six more nuclear-powered submarines, for a guided missile cruiser powered by two nuclear reactors, and for the largest aircraft carrier in the world, which will be powered by eight nuclear reactors. The total number of power producing reactors existing and definitely planned is 83. Each week this number goes higher.

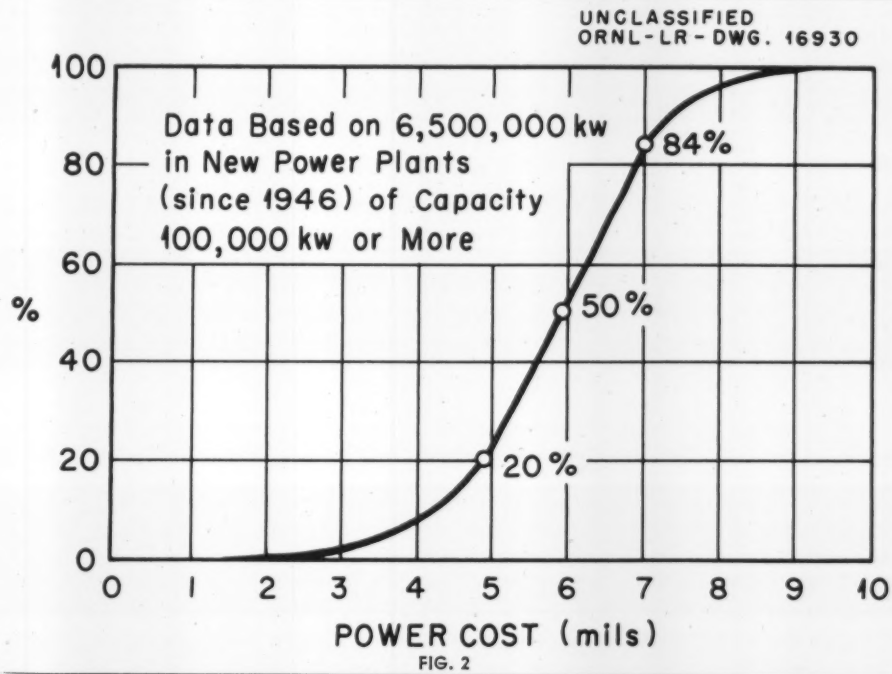


FIG. 2

IGNORING military reactors for the moment, and concerning ourselves solely with the civilian nuclear power program, we find that plans have been made for the government to spend 313 million dollars on building nuclear reactors for producing power and for private industry to spend 358 million dollars. The reactors covered by these plans will have total electric power generating capacity of 1,182,000 kilowatts. So one of the opportunities that is here right now is for manufacturers to provide the material and equipment needed in constructing 671 million dollars worth of nuclear reactors in the next four or five years. If power produced by these reactors is sold at an average price of 6 mills per kilowatt hour, then the annual revenue from sale of power will be something like 50 million dollars.

At this point, perhaps we would do well to spend a few minutes comparing nuclear power versus power from conventional fuels to see if we can evaluate the prospects for achieving low cost nuclear power. In the first place a nuclear power plant basically is exactly like a conventional power plant except for the source of heat. Therefore, we can automatically rule out any possibility of saving anywhere except in the source of heat.

We have already discussed the fact that nuclear energy is always produced in the form of radiation which has many of the characteristics of x-rays. This radiation can be converted into heat, but we must remember also that it is deadly to living things. Therefore, we can expect that our nuclear power plant will require heavy and expensive radiation shielding around its fire box.

Conventional power plants are characterized to a large degree by the tremendous quantities of fuel required for their operation and by the influence of

Power Reactors

Owner	Location and Completion Date
UNDER CONSTRUCTION	
General Electric Co. and Pacific Gas and Electric Co.	Near Livermore, Calif. — 1958
AEC and Duquesne Light Co. (Pressurized Water Reactor)	Shippingport, Pa. — 1957
Power Reactor Development Co., Inc.	Monroe, Michigan — 1960
PLANNED	
Consolidated Edison Co. of New York	Indian Point, N. Y. — 1960
Commonwealth Edison Co. (Nuclear Power Group)	Dresden, Ill. — 1961
Yankee Atomic Electric Co.	Rowe, Mass. — 1960
Consumers Public Power District	Beatrice, Nebraska — 1960
Rural Cooperative Power Assoc.	Elk River, Minn. — 1960
Wolverine Electric Cooperative	Hersey, Michigan — 1959
Pennsylvania Power and Light Co.	Eastern Penn. — 1962
Florida Power Corp., Florida Power and Light Co., and Tampa Electric Co.	Florida — 1962
Chugach Electric Assoc., Inc., and Nuclear Development Corp. of America	Anchorage, Alaska — 1962
City of Piqua, Ohio	Piqua, Ohio — 1960
Nuclear Merchant Ship Reactor	
University of Florida (Small Power Reactor for Research)	Gainesville, Fla. — 1959
City of Holyoke, Mass.	Holyoke, Mass. — 1961
City of Orlando, Florida	Orlando, Florida — 1961

Research and Test Reactors

COMPLETED

Pennsylvania State University
Raleigh Research Reactor (North Carolina State College)
Armour Research Foundation (Illinois)
Naval Research Laboratory (Washington, D. C.)

UNDER CONSTRUCTION

University of Michigan
MIT Research Reactor
Aerojet-General Nucleonics (California)
Battelle Memorial Institute (Ohio)

PLANNED

Washington State College
UCLA Medical Reactor
Industrial Research Laboratories, Inc. (New Jersey)
Watertown Arsenal (Massachusetts)
The Prosperity Co. (Coral Gables, Florida)
Dow Chemical Co. (Michigan)
University of Washington
University of Buffalo
Gamma Corporation (Massachusetts)
Stanford Research Institute (California)

the cost of this fuel upon the final cost of the power produced. By way of comparison, I might point out that nuclear power plants require only very small amounts of fuel. As an illustration, the entire world's energy demands for 1955 could have been supplied by the nuclear power produced in consuming an amount of uranium fuel equivalent to an 8-foot cube of uranium metal. From this we would expect that transportation costs associated with the fuel for a nuclear power plan are going to be very small, no matter how far the fuel has to be shipped.

In a conventional power plant once the fuel is burned, the ashes, gases or other products of combustion can be disposed of with little difficulty and at virtually no cost. But the ashes of a nuclear power plant are highly radioactive fission products, which cannot be disposed of so easily. They must be stored in places from which they cannot escape and in which they are surrounded by shielding so that their radiation will not be a hazard. Storing radioactive fission products in leak-proof, shielded containers is expensive.

The radioactive ashes from our nuclear power plant also create another problem. Because a little bit of fuel goes a long way in a nuclear power plant, the ashes build up to a point where they will quench the fire long before all the fuel is consumed. This means that in our nuclear power plant we must provide for chemical processing of the uranium fuel to remove the radioactive fission product ashes, either continuously or periodically, so that they do not interfere with the operations of the power plant. Chemical processing is expensive, but it is the only way that the radioactive fission products can be removed from the uranium fuel.

So it looks like we are forced to the conclusion that a nuclear power plant will cost more to build than a conventional power plant. It probably will cost more to operate, what with chemical processing of the fuel, special precautions for protection from radiation and the special provisions required for disposing of radioactive wastes. We might sum up by saying it appears that in our nuclear power plants we will exchange the cost of transporting and handling large quantities of fuel in a conventional plant for the cost of chemical processing, radiation protection and waste disposal in the nuclear plant. If the total fuel costs, including processing, can be kept sufficiently low, the nuclear power plant may produce cheaper electric power than conventional power plants. So you see much depends upon our developing a reactor that uses fuel which can be processed easily and upon our developing economical methods of processing.

We at the Oak Ridge National Laboratory believe we have come up with a type of reactor that offers great promise in this direction. This is the so-called homogeneous reactor on which we have been working energetically for several years now. The homogeneous reactor has the unique feature that its fuel is not a metal alloy at all, but is an aqueous solution of a uranium salt. This type of fuel is in an ideal form for chemical processing. Recent developments have given much encouragement that the processing required to remove virtually all of the fission products may be as simple as a continuous filtration of the aqueous solution. If this should prove to be feasible, the chemical processing cost associated with a homogeneous power reactor would be very low. The problems of dissolution of irradiated fuel elements and refabrication of the processed uranium into new metallic elements are avoided altogether.

WHILE we are enthusiastic and optimistic about the future of homogeneous reactors, I should in all fairness point out that great strides are being made in improving the economics in other types of reactors. For example, the Yankee Atomic Electric Company has developed an improved version of the power reactor being constructed at Shippingport, Pennsylvania, and has estimated that fuel costs in their reactor, including chemical processing and all other charges, will amount to 2.5 mills per kilowatt hour.

But even if the basic costs of producing nuclear power are high, there may be compensating factors. For example, the radioactive fission products that are removed from reactor fuel by chemical processing are a potential source of profits for the power plant operator. The Oak Ridge National Laboratory is now realizing something over 2 million dollars a year from the sale of radioisotopes, many of which are fission products. In addition to the fission products, the operator of a nuclear reactor can produce radioisotopes of *any* sort at very little additional expense by making provisions for irradiating materials inside of or adjacent to his nuclear reactor. These will have value for many applications which we shall discuss in more detail later.

ANOTHER possible source of profit arises from the fact that nuclear energy is given off by atomic nucleus in the form of radiation. Intensive study over the past few years has shown that radiation has an effect upon almost everything exposed to it. Sometimes the effect is beneficial and sometimes it is detrimental. As an illustration, the Oak Ridge National Laboratory discovered that some of the plastics manufactured by the parent operating company, Union Carbide, become stronger after exposure to radiation. Naturally, Union Carbide is devoting an appreciable amount of effort to looking into this phenomenon.

Radiation will kill living organisms, from bacteria, molds, fungi, up to and including man. On a basis of this knowledge considerable effort is now being devoted to studying the possibility of utilizing radiation to kill bacteria and molds that cause food of various sorts to spoil. The work to date has shown that certain foods can be sterilized by radiation to become far less perishable and even to keep without refrigeration. The potential profits from radiation-sterilized foods—meats, for example—that require little or no refrigeration are enormous.

Anyone who constructs a nuclear power plant will be generating tremendous amounts of radiation and radioactive materials at the same time he is generating power. These valuable by-products represent a potential source of revenue that the conventional power plant does not have.

We have already mentioned the fact that conventional power costs are highest in those areas where fuel costs are high. Nuclear power plants use such small amounts of fuel that transportation costs are negligible, therefore, we can expect that a nuclear power plant producing electric power for 7 mills per kilowatt hour can still produce power for that cost even in regions where the conventional power cost is 8 or 9 mills per kilowatt hour, as it is in some parts of the United States.

This could have rather far reaching effect. The location of industrial plants quite often is fairly strongly influenced by power costs. Reducing high power costs in some areas may remove the obstacle that has kept industry out of that area. When nuclear power has its effect in the direction of equalizing power rates around the country, we may see an acceleration in the trend of industrial relocation that has been underway. This will provide many new opportunities for the South—and there are more.

One of the most challenging nuclear energy opportunities is that of finding profitable ways of using the radiation and radioactive materials that are by-products of nuclear power plant operation. To give you some ideas of the progress that has been made—and of the opportunities that already exist—let me cite a few examples. Among the most outstanding uses have been the medical treatments in which radioisotopes have been used to cure certain diseases that could not be cured any other way.

Perhaps the most interest recently has been concerned with the radioisotope radiation sources used as a substitute for and improvement over conventional x-ray for treatment of certain diseases. A cobalt-60 radiation source weighing a few ounces has mobility that could never be achieved with any sort of x-ray machine. This makes it possible to rotate the radiation source completely around a patient's body, concentrating the radiation on a deep-seated tumor and giving the tumor a much heavier dose of radiation than is received by any of the healthy tissue around it.

The radiation will kill the tissue of the tumor without seriously injuring the healthy tissue around it. Unfortunately Cobalt-60 is not a fission product and consequently must be produced by irradiating ordinary cobalt in a nuclear reactor. Recently, radioactive cesium 137, which is a fission product and therefore is available in larger quantities, has been used as a teletherapy source with some advantages over cobalt. One of the major products of the new Fission Products Pilot Plant at ORNL will be cesium 137 for radiation sources.

I suppose that it is in the industrial uses of radioisotopes that the most spectacular advances have been made. There are now so many different uses that I cannot hope to discuss them all, I will try only to give a few examples of some typical applications in which various characteristics of the radioisotopes are exploited. The fact that radioisotopes emit penetrating radiation similar to x-rays makes it possible to utilize a small radiation source, which is perhaps as big as a pea, to make x-ray pictures of castings, welds, poured concrete, or other solid materials in which internal flaws would be difficult to detect. Because of the smallness of the radiation source, it can be placed inside of pipe or in a valve body, or in other small areas where ordinary x-ray machines, even if they were not prohibitively expensive, would be useless because of their large size.

Another characteristic being utilized in many industrial applications of radioisotopes has its basis in the fact that radiation intensity is reduced in direct proportion to the thickness or density of the material through which it passes. Thus it is possible by measuring the quantity of radiation transmitted through materials that are manufactured in continuous sheets to determine the thickness of the sheet continuously and accurately. It is possible to arrange the radioactive source thickness gauge in such a way as to measure thickness continuously and accurately and to make automatic corrections for thickness variations in the production process.

ONE LAST type of industrial application of radioisotopes I would like to mention is the very valuable tracer studies that can be performed with radioactive atoms. The uses here are many and varied. A few typical examples would include tracing the flow of materials through pipelines, detecting leaks in hidden pipelines, and following the flow, mixing, or dispersion of materials in an industrial process.

This partial listing of some of the uses of radiation and of radioactive materials hits only a few high spots of the profitable methods that have already been devised for exploiting the unique features of nuclear energy. I might point out that even a year ago it was estimated that the annual savings being realized at that time by American industry through the utilization of radia-

tion and radioisotopes was about 100 million dollars per year. This estimate was made by one of the Atomic Energy Commissioners, who went on to say that in his personal opinion the savings would increase by 1964 or 1965 to somewhere in the neighborhood of one billion dollars per year.

Speaking broadly of the South as a whole, I believe that perhaps the greatest opportunity afforded by nuclear power will be that of exploiting its unique features. Experience over the past ten years strongly suggests that in every state, every town, even every industry there are almost sure to be certain operational problems to which nuclear energy can contribute an economical solution. It may very well be that nuclear power will make its greatest impact on the South as a result of the successes achieved in utilizing radiation and radioactive materials, which are by-

Here then is a real challenge to the industries of the South; find ways in which the unique features of nuclear energy can be exploited to the advantage and increased profits of your own organization. Encourage your schools, colleges and universities to establish the educational programs required to turn out the specially trained people you will need. Participate with other industries and with governmental agencies in the further development and exploitation of nuclear power and then be prepared to take advantage of the technological advances that are achieved.

Certain areas of the South, notably Florida, are almost certain to realize lower power cost as a result of the fuel cost savings made possible by nuclear power plants. It stands to reason that industrial opportunities in Florida and in other high-power cost areas will be considerably more attractive once these power costs are reduced. Therefore, those who are giving consideration to industrial expansion should be prepared to take advantage of the opportunity to move into attractive new industrial areas that will be opening up.

TRENDS already established suggest that much of the increase in power demand expected over the next 20 years will be required in the South. Therefore, the encouraging progress that has been made to date in planning for nuclear power plants to meet their share of this growing need should certainly be continued. Those who plan to construct nuclear power plants would do well, I think, to keep themselves well posted on the opportunities that become available to turn costs into revenue by the profitable utilization of the by-product radiation and radioactive materials. Of course the construction industry will be expected to build the nuclear power plants. Here I might point out that if we achieve our goal and construct nuclear power plants to provide 15 percent of the 300 million kilowatts of installed capacity estimated to be required by 1975, then the construction cost alone will be in excess of 10 billion dollars. The sale of power from these nuclear power plants at 7 mills per kilowatt hour would bring in revenue of one billion dollars per year. Keep in mind that this is revenue from an industry—the nuclear power industry—that does not even exist now. It does not include any allowance for revenues or savings realized from the utilization of the by-products of nuclear power plant operation.

As you can see, I am very enthusiastic about the future of nuclear energy and particularly about nuclear power opportunity for the South. I think that here is probably the greatest challenge that has faced our Southern region, and in fact, the United States as a whole for many years. It creates tremendous new opportunities and offers exciting promises of still greater new things to come. It is my earnest hope that American industry, by exercising the ingenuity and initiative for which it is famous, will meet the challenge of atomic energy, seek out the opportunities for its utilization, and reap the rich rewards for success in these endeavors. ■

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Mr. Maddock has been associated with machinery financing for more than 30 years. He joined the C.I.T. organization 25 years ago and became president of C.I.T. Corporation in 1948. He is currently also vice president and director of the parent company, C.I.T. Financial Corporation. During World War 1 he served as Director of Administration of the War Trade Board, later spent several years in China with the American International Corporation. Mr. Maddock is also chairman of the executive committee of The Tuition Plan, Inc.

SYDNEY D. MADDOCK

Industrial Financing— Its Role In Distribution

by Sydney D. Maddock

President
C.I.T. Corporation
New York

TO ME, and, I'm sure, to anyone who thinks about it, this is something of a miracle in the effectiveness of modern processing and distribution. For instance, it hardly seems possible that shrimp taken from the cool deeps 800 miles or more from some Gulf fishing port can show up on the plate of someone a thousand miles inland, a mile above sea level, and still be almost ocean fresh, even though weeks or months may have intervened.

This miracle of modern distribution becomes even more impressive when I trace the journey made by the shrimp from sea to consumer. It isn't a simple journey. To be a successful journey at all it involves some nice timing, some intricate meshing of men, machines and money. To bring a low-priced package of frozen shrimp to your table means the employment of a good bit of skill and experience and a big outlay of expensive machinery and equipment.

Almost every piece of equipment involved can be — and usually is — financed for the buyer in some way. The use of sound instalment financing makes the distribution of fresh shrimp from ocean to your table more economical and more efficient. To borrow a phrase from the war days: the industrial financing organization is the indispensable man behind the man behind the gun.

Let's use this example of frozen shrimp as a case history and see at how many points its journey is hastened or made more economical and efficient by time-financed equipment.

No more than a decade ago, the average Gulf shrimper was operating profitably with vessels some 50 feet in length, with an 800-gallon fuel capacity and space for maybe 15 tons of ice. The vessel cost about $15,000, on the average. The fishing grounds were nearby— 25 to 50 miles from port—and the shrimper could return to base every night; at the most, within the week.

During the past decade great changes have come to the fishing industry. For one thing, fishermen have been forced to travel to more distant grounds and to take their catches from greater depths, and the development of modern electronic equipment also has added to the expense of competing.

Today a successful shrimper in the Gulf is operating a vessel of 75 feet or more in length, with horsepower up to 200 and more and with fuel capacity of 4,000 to 6,000 gallons. These far-ranging vessels are working hundreds of miles from port and may stay out for many days, in fair weather and foul.

These modern trawlers carry electronic depth recorders that can be used in locating catches. They carry radio compasses, automatic pilots and expensive refrigeration equipment. These vessels cost from $40,000 to $100,000.

Shrimping is profitable for a skilled captain, but few are able to afford cash for vessels in this price range. Even those who can wouldn't want to tie up their capital to such an extent. Money must be employed just as wisely and as skillfully as are men and machines, otherwise profits are curtailed.

So right here, before the average captain even puts to sea, an industrial financing company is able to speed his trip, conserve his capital. With proper financing, geared to his own exact needs, he is able to acquire a modern vessel that will pay for itself as it earns.

Industrial financing companies have for years financed many kinds of income-producing vessels, including fishing vessels. We also finance the installation of machinery and equipment in vessels—new engines, radios, navigational aids, refrigeration equipment.

Usually the terms on a shrimp trawler call for a down payment, with the balance to be paid in three years in equal instalments. Naturally, this is not an invariable rule and contracts on some of the larger boats have been written with terms of five years.

I would like to remark here that one

This article was given by Mr. Maddock as an address before the 28th Annual Boston Conference on Distribution at Boston on October 22, 1956.

of the important items to be checked in financing a trawler is the experience and skill of the captain. Many of these remarkable men can neither read nor write. In some cases we have furnished them envelopes for each instalment with the amount of each payment written in. I remember one capain who took his envelope to the bank every month, listened while a teller read him the amount of the payment and then casually peeled off $100 bills from a truly astounding roll of cash. The bank would then mail us a draft for the payment. This captain, however, and his fellow captains — regardless of their lack of formal education — are men of integrity and great skill. They are excellent credit risks.

AN IMPORTANT part of this financing —the major portion of it—is done through the engine dealers or yards. They ordinarily are not so capitalized as to be able to carry large quantities of notes with their own funds. We discount completed transactions for them in order to replenish the dealers' or yards' supply of cash. In helping the yard attain a better profit, of course, this financing also benefits the fisherman, and the benefits extend, step by step, to the ultimate consumer.

When the successful shrimper returns to port with his refrigerated catch, the shrimp must be skillfully unloaded, washed, graded for quality and headed and graded for size. This was a tedious hand operation until just a few years ago. But today, with a one dollar-an-hour minimum wage, heading and grading is done with a newly-developed machine at a lower cost per barrel.

If the shrimp are to be frozen they must be properly packed for the operation, frozen, glazed, and properly stored at just the right temperature. Perhaps, in addition, the frozen shrimp may be breaded. Close to half of all shrimp production is now going through breading plants. And they must be packaged for the consumer and prepared for shipment.

All in all, whether the shrimp or any other product is to be frozen or canned, or sold fresh, equipment is necessary to maintain quality, avoid waste and increase profits. Proper equipment is becoming more and more important in this type industry and the slower methods of processing and packing by hand are disappearing.

Many of these processing and packing companies are small operations. Proper financing is very important to most of these businessmen if they are to operate efficiently and profitably. They must have the proper machinery and equipment without weakening their working capital position. They are working with highly perishable products that must be processed and packed correctly and quickly.

The important thing to these packers is to obtain terms that are geared to their needs, terms that fit the pattern of their income. So again we find that sound, flexible financing from an industrial financing firm can permit these packers to modernize their operations to increase efficiency and profits, while reducing the price to the consumer.

The terms they can get on equipment vary because there is a wide variety of equipment involved. And there are other variable factors such as the amounts involved and the standing of the buyer. In any event, terms are set that suit the need. On some of the equipment used by these packers, terms may run to 10 years and payments can be geared to the new, faster depreciation allowed under the 1954 tax schedules.

On its trip to the consumer outlets the product will encounter materials handling equipment, one of the biggest categories of equipment financed by our firm. It will travel in refrigerated trucks, probably financed by an industrial finance company. And it will travel over highways built more economically because contractors were able to buy modern construction equipment on long terms geared to depreciation and to their income. Every hour trimmed from this trip by better highways, every factor speeding up the shipment, results in savings to the sellers and to the consumers.

As final steps, the consumer package is placed in a supermarket, safely frozen in a refrigerated display case. When it leaves the market it is checked out over a modern check-out counter and cash register. And here again we have pieces of equipment often financed for the market operator by the industrial finance firm.

I suspect the percentage of housewives who ever heard of an industrial financing company is a very small fraction of 1 per cent. But all of them—and all of us—have been indirectly affected by this relatively new source of industrial credit. In a competitive economy, the consumer is the beneficiary of any improvement in financing production, processing and distribution.

I have traced just one consumer product. Similar stories could be told of thousands of other products. C.I.T. Corporation alone handles the instalment financing of industrial and professional equipment used in practically every field of endeavor. Growth, particularly since World War II, has been amazing. I must use our own firm as an example, but growth is typical of the entire field. Since the war, C.I.T. Corporation's volume of financing has multiplied several times. In construction equipment, for example, it has more than tripled just in the past five years. And this year, overall volume is running some 60 per cent ahead of the record 1955 level.

Now, something must have been lacking in the sources of credit available to users of machinery and equipment to make such growth possible. Industry, competing for the consumer's dollar, striving for wider distribution of goods, wanted a certain kind of credit. More than anything else, I think, the older credit sources lacked flexibility.

Of course, there have been other factors in the growth of the industrial finance company. We have been aggressive in seeking busines. We have offices and field representatives throughout the nation. The economy has been growing rapidly. But mostly we have grown because we have created for machinery users finance plans tailored to their precise needs. We have created finance plans for individual manufacturers and distributors — plans that have given them powerful new sales tools.

THERE are, actually, only a few basic ways a buyer can pay for machinery or equipment, whether it's a shrimp trawler, a fork-lift truck, a dairy or a bakery or a giant earth-mover. He can pay cash. He can get a short-term bank loan. He can arrange a capital issue. He can get limited credit from the manufacturer or distributor of the equipment. Or he can use an industrial financing company.

A straight cash purchase, often thought of as the cheapest way to buy, can be the most expensive. A cash purchase can be ruinous when it depletes working capital and the buyer later has to pass up favorable cash purchases of inventory or winds up short of operating funds to meet regular or unforeseen demands.

Generally, a bank loan is used for working capital loans rather than for the purchase of equipment. The usual term is too short for any substantial purchase. Also, the use of bank credit

for machinery purchases draws down the borrower's open line of credit, which should be kept for current requirements. And, in addition, it is hazardous to fund capital requirements so that the borrower is dependent on short-term renewals.

There are also certain advantages and disadvantages in the financing of capital investment by bonds, debentures, preferred or common stock. Usually, machinery and equipment purchases do not involve amounts large enough to make this form of financing economical. The smaller the amount involved, the higher the coupon or dividend rate will be. And the larger the underwriting commissions and expenses will be in proportion to the money obtained. Total financing expenses of a small issue may amount to 10 or 15 per cent, or more, of the amount of net proceeds.

The next source—credit from the manufacturer or distributor of the equipment—is sometimes used when equipment purchases are in limited amounts. However, manufacturers and distributors generally feel that it is not their function to serve as banker for their customers. Many can't afford to. Many others don't want to be burdened with the necessary credit-checking and bookkeeping. Most of them are turning all credit sales over to industrial financing firms. And an increasing number of buyers are turning to the financing firms on their own. This is particularly true when they want to buy from several sources and pay for all the purchases on one contract.

THE USUAL instalment deal is a simple conditional sales contract. Buyer furnishes the seller, or the finance firm, with the details of the proposed purchase and gives him the customary financial data about himself or his company. When his credit is cleared, he makes a downpayment and completes the documents provided by the industrial finance company. The financing company pays the seller the balance due on the equipment. The buyer subsequently makes monthly payments to the financing firm.

The cost of the financing varies and terms vary to suit the individual situation. Sometimes monthly payments are skipped altogether during off-seasons—such as the winter months for payments on soft drink vending machines or slack seasons on canning and packaging machinery.

Earlier, I mentioned that some instalment contracts gear the payments to the new depreciation schedules. That is, payments are larger in the early years when depreciation allowances are large and taper off as depreciation allowances taper off in later years. In effect, the buyer pays for his new equipment by means of its own depreciation, without digging deeply into his working capital.

This type of financing—called Pay-As-You-Depreciate financing — was developed by C.I.T. to permit buyers to take advantage of the faster depreciation schedules. It answers just about all the needs of a machinery buyer and I consider it one of the most important developments ever made in industrial financing.

Under this kind of plan, the purchaser can pay for new machinery at substantially the same rate it can be depreciated instead of in equal monthly instalments. This makes the relationship between his depreciation reserves and expenditures for capital equipment much more realistic.

Terms on this type of financing generally are longer, stretched out to more nearly match the depreciable life of most machinery. Ten years on machine tools, bakery equipment, textile machinery, packaging machinery, printing and wood-working machinery and dairy equipment. Six to eight years on lift trucks. Six years on construction equipment and so on.

This financing program has been an important factor in the conduct of many an industrial firm. It is designed strictly for industry and some of the professions and bears no relation to consumer instalment credit. In fact, most consumers never heard of industrial financing firms. But, as I pointed out earlier, in a competitive economy any improvement in the methods of production and distribution of goods benefits the consumer brings him a higher standard of living at a lower cost.

The use of industrial instalment credit, to be sure, benefits the consumer indirectly; he is the beneficiary once removed. The first benefits go to the sellers and buyers of the machinery used to create consumer goods.

Now what are these benefits exactly? What does proper financing do for industry that makes it possible for industry to pass along better products and better services to the nation's consumers?

Flexible instalment financing helps the buyer of machinery and equipment because: it gives him longer, more realistic terms; it adjusts his payments for the equipment to the pattern of his income; it preserves his working capital and improves his financial statement; and it provides him with a reliable new source of credit; it helps him modernize to maintain his competitive position.

Sound instalment financing benefits the distributor, the seller of equipment because: it frees his salesmen from time-consuming credit and collection jobs and makes that time available for customer coverage; it improves customer relations; it makes more sales and larger sales; it turns all sales into cash for the seller and frees him of credit responsibility; it frees bank lines for inventory and operating uses; and it gives him the benefit of help from a national organization familiar with his field and his customers.

THESE benefits speed the distribution of goods just as the invention of a new conveyor system or machine tool makes life fuller and more enjoyable for the average American family.

But a new lathe or drill that will improve automobiles or electric fans, tractors or television, cannot improve anything until it has been put to work. A new process for packing food or paving highways or displaying merchandise will bring no benefits to anyone until the equipment necessary is produced, sold and put to work.

I like to believe that the role of the industrial financing company in helping men put these machines to work has been an important role in the development of our unprecedented standard of living. Being able to enjoy a fresh shrimp cocktail in Wichita or Denver may not be very important. But the story of how it became possible is important. And it's indicative of our growing economy. It illustrates how the fantastic growth of industrial instalment financing is influencing American business.

Most important to me is the fact that the industrial finance company is still a virtual infant. It has just begun to grow. "What is past is prologue." ■

S.A.M. National Meetings 1956-1957

Executive Committee Meeting—February 16, 1957

Board of Directors Meeting—April 27, 1957

Executive Committee and Board of Directors Meeting—June 15, 1956

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J. L. MEIJ

The Span Of Control— Fact And Fundamental Principle

by J. L. Meij

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In *Advanced Management* of November 1955 my attention was drawn to an article by W. W. Suojanen: The span of control, fact or fable. As I published a paper on this subject at the same time in *The Journal of Industrial Economics* of October 1955 I have read Suojanen's contribution with the utmost interest. I suppose he paid the same attention to mine, if he has seen it. However, as *The Journal* cannot be expected to have the same group of readers as *Advanced Management*, it might be of some interest to the readers of this periodical to play my view against Suojanen's.

It should be pointed out that I cannot wholly repeat my argument; only my conclusions can be mentioned and for the rest I must refer to my article in *The Journal*. The outcome of Suojanen's reflections is that the idea of a limited span of control put forward by Graicunas, Davis and others, is a mere fable. In my paper I have stated, on the contrary, that the span of control can be considered as the fundamental principle of a by now still missing theory of organization.

What might be the reason for such a large divergency. Suojanen's first argument is that in practice there is no indication for the existence of a limitation of the span of control to a certain number of subordinates. As follows from an investigation of the A.M.A. the number of executives reporting to their chief was in general much greater than the number derived from Graicunas' formula. As most of the business-leaders in our days are spending a considerable part of their time outside their companies, their span of control can be estimated practically even twice as high as follows from the A.M.A. report.[1]

A second objection of Suojanen to the theory of the span of control has a more theoretical character. As he remarks, the span of control principle was borrowed from the military organization and then applied by theorists in administration to non-military organizations. The basic error that was committed in adapting it to non-military situations arose from an improper appreciation of the contrast between active military as opposed to Civil operations.[2] The fact that the uncertainty in military operations is much greater than in civil practice, was neglected by those who tried to apply the span of control concept to non-military organizations. The civil large-scale organization can reduce most of its operations to a routine, requiring a minimum of detailed direction.

Thirdly, in the author's view the span of control principle seems to be somewhat obsolete. It was advanced before social scientists had become aware of the importance of primary relationships and the role they play in the formal organization.[3]

Those relationships lead to the coming into existence of groups or unit organizations wherein an intensive coordination is assured, so that it can be said that the unit organization acts as a single person. This means less work for the superior as the number of cross and indirect group relationship that he must consider is substantially reduced. Those relationships are to be controlled by the group, not by the individual. The coordinating authority belongs to the group, not to the individual and therefore the span of control can be widened indefinitely. The role of the chief executive becomes one of coordinating the efforts of the coordinating group and not those of individuals.

With the above I think I have put forward the most relevant point in Suojanen's argument for his rejection of the span of control as a basic principle of organization.

In my article in *The Journal of Industrial Economics* an attempt was made to build up a framework for a theory or organization in which the span of control was considered to be a fundamental concept.

In my view the span of control is one aspect of the scope of control; the

[1] Advanced Management, *Nov.* 1955, *p.* 6-7.
[2] *o.c., p.* 9.
[3] Advanced Management, *Nov.* 1955, *p.* 9.

depth of control is the other one. Control is more dimensional. The span of control concept considers control in the width i.e. horizontal. However, control has also a depth insofar as it relates to the penetration of the leader's will through the different levels of management to the ultimate operators. The starting point for the theory of organization can be found, in my opinion, in the necessity to enlarge the scope of control in accordance with the growth of the business. From this necessity the general principles on which the organization rests can be deduced and the fundamental measures of which the organization consists can be explained.

I reject the mechanistic concept of the span of control just as Suojanen does. The scope of control cannot be the outcome of an algebraic formula only. However, in my opinion, the idea that organization principally consists in widening and deepening the control can be used as a basis for a theory of organization.

SUOJANEN rightly states "that theory of organization that has been developed has not been built around any general frame of reference but has rather emerged as a series of principles of administration." Nevertheless we can start the development of such a theory by regarding organization as a struggle for widening and deepening the leader's scope of control.

In my paper in *The Journal of Industrial Economics* I pointed out that the principal measures of organization as the splitting of constitutional work from the leader's task, standardizing, budgeting and several other principles modern organization rests upon, can be considered as means for widening and deepening control. They can be compared and scrutinized in relation to their influence on the scope of control.[4]

The question of whether or not the span of control is by nature limited to a given quantity of subordinates or whether or not the depth of control is limited to a certain number of levels is quite irrelevant. What is important only is that organization consists in widening and deepening control. As Suojanen states, the span of control concept was advanced before social sciences had demonstrated the importance of the coming into existence of groups. I think this is only true for the original version of the concept. It does not say anything in regard to the possibility of adapting it to the results of modern thinking. The span of control, far from being a given and unchangeable quantity, depends on the leader's qualities, the work to be performed and last but not least on the quality of the subordinates. We can widen the span of control by measures acting on each of these three factors. Group relationships and group formation refer to the last factor.

There is, however, still a danger in the way Suojanen handles the phenomena of group-formation and group-coordination in business. As he says coordinating authority can exist in a group of people as well as in a single individual, we must be aware of the fact that perhaps this is possible in top-management but not on the lower levels. The supreme coordinating authority can be located in a board consisting of several persons. They can formulate the general policy of the company, the objective of the enterprise and the ways and means to attain them. Nevertheless it is true that in the board there is and there must be a member who has a certain authority over its co-members. This seems not only necessary to bring board discussions to conclusions but also to maintain the necessary unity in policy-making. One can reject the unity in command as belonging to military organizations only but this does not imply that there must not be unity of policy.

But now what about the lower levels of management? There is a substantial difference between top-management and lower management. At the top we can have a board in charge of the general policy of the company. Under extremely favourable conditions we can expect the board, as a group, to act as an individual, so that there is a total unity of policy. The development of group-relationships however is not limited to the group at the top. Group formation on lower levels has a totally different origin and significance. Insofar it is informal, it does not originate from the organizational structure of the company. Moreover, it is not created to realize the objectives of the business. Therefore we cannot have the lower groups acting as if they were more or less autonomous bodies. In my terminology we can say that many times the development of groups at lower levels of management or among the ultimate operators act against the penetration of the will of the leaders in the lower regions of the business. Those group-formations, if widening the span of control, call at the same time for measures on behalf of deepening the scope.

If leaders wish to make use of group-relationships and group-activity they must try to let the group accept the objectives of the business as their own. But this is not possible without giving directives and help to the members of the group; here the span of control and the depth of control are becoming important. It might be granted that much can be done by mutual aid of the group-members themselves but the activity of the group always must be coordinated and directed to the final objectives of the company.

[4] *Journal of Industrial Economics, October 1955, p. 23 and further.*

CHAPTER HONOR ROLL

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COLUMBUS	8
GREENSBORO	7

This can only be done by the leader of the group who derives his authority from delegation by the top. Further we must avoid exaggerating—under the influence of sociologists—the importance of formation of groups and group-relations at the level of performance. As labourers in many cases often change their positions and their job, there cannot be a tendency to the development of a strong relationship. This is not always a drawback. If group-relationships have developed into a close-tied body acting as an individual we loose the mutual check which is of an importance we may not neglect. As Suojanen says, the coordinating activity of the group diminishes the leader's task, we can agree with him, but we must not forget that there is also a controlling activity. The more the group acts as an individual, the more the importance of mutual checking diminishes and as a consequence the more difficult the pure controlling task of the leader becomes.[5]

THERE is still a point, not stressed in Suojanen's considerations, that seems extremely important to me.

The scope of the leader's control can be widened and deepened by adequate means. It must be done if the firm is growing. But with the growing scope the responsibility grows in the same degree. The manager cannot bear this responsibility if he does not have the consent of the group he is leading. Therefore he must take into account the opinion of his group. Its members must be convinced of the adequacy and rationality of his directives. In my opinion here in particular the existing of groups is important for the leader. The group must accept the leader's decision as it were its own and as a consequence be ready to share the responsibility with him. We can say that making use of the group-sense the leaders span of responsibility widens.

To conclude I would state that a theory of organization cannot reject the span of control or consider it as a fable: this would mean removing one of its most fundamental principles. However, if we wish to give the span of control, being but one dimension of the scope of control, its appropriate place in organization-theory, we may not interpret it as an unchangeable quantity. The fundamental viewpoint of the theory is that all organization is a struggle for enlarging the scope of control in its width as well as in its depth. ■

[5] *The Journal of Industrial Economics, vol. IV, no.* 1 *o.c., p.* 3.

CIPM Reports . . .

Visiting A Viennese Company

LAST AUTUMN the writer visited a Viennese firm whose president took an active part in the management seminars held in Austria in 1952 under the joint auspices of CIPM, the U. S. and the Austrian governments. The name of the firm is Kraus & Naimer, and its products are low volted, switch gears. Since the end of World War II, Hubert Naimer, its president, has changed the organization from a small, family-operated firm, employing fifty workers on the same craft basis used when the company was founded fifty years earlier, to a scientifically laid out, dynamically managed company with over 300 employees. Mr. Naimer attributes much of his success in effecting this metamorphosis to the seminars on production management, marketing, personnel, and financial management that he attended in 1952.

In walking through the plant, the writer observed the tastefully decorated executive offices, the new building that was being erected on one side of the courtyard of the company's lot, the employees' dining room, where a full luncheon may be had for about forty cents, and the light, pleasant working spaces for all the employees. The plant is airconditioned throughout, and Mr. Naimer has installed IBM machinery for order records and production control planning. Within a short time he hopes to put in electronic data processing equipment.

The employees of Kraus & Naimer have shared the benefits of their employer's abounding enthusiasm for the management ideas propounded at the seminars in 1952. Several years ago Mr. Naimer proposed to his employees that an incentive plan be installed. Upon hearing the proposal, they went out on strike, fearing a new, untried plan would mean more work and less pay. Mr. Naimer explained the advantages they would derive from an incentive plan, won the strike, and installed the system. As a result, the wage rate in 1955 was 25% higher than it was in 1952. Unfortunately, the legal wage increases decreed almost yearly by the Austrian government made the addition of an incentive plan too great a financial burden for the management of the company, so until different legislation goes into effect, the incentive plan has been discontinued.

As a management leader in Austria, Mr. Naimer has not confined his activities to the development of his own company. He is a member of a group of Austrian businessmen who have continued to hold seminars patterned on those conducted by the Americans in 1952, and he is one of a number of managers who look with favor on the introduction of management courses in the curricula of Austrian universities and other educational institutions.

Kraus & Naimer is only one plant, in only one country in which management seminars have been held, but just as the automobile salesman feels a sense of pride when customers buy and use his cars, so CIPM and the many management men who have participated in its international management seminars feel a sense of accomplishment each time a technique —and more important — a *management attitude*, is successfully adapted by managers of another country.

Jane Dustan, CIPM Editor

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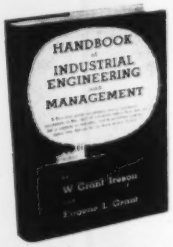

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Mr. Suojanen has combined business with teaching, having worked for Uarco Business Forms, National Automotive Fibres and Safeway Stores, Inc., while teaching at the University of Vermont and the University of California at Berkeley, where he is currently Assistant Professor of Business Administration. Mr. Suojanen received his B.S. degree from the University of Vermont. After Army service he received his M.B.A. from Harvard and a Ph.D. from the University of California.

WAINO W. SUOJANEN

Notes On General Theory Of Management

by Waino W. Suojanen
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Professor Meij's arguments in favor of limited span of control revolve around two basic concepts. The first of these—the width of the span of control—can be considered as the problem of exercising lateral or horizontal authority. The second, and one that is often not fully appreciated, is the corollary question of the depth to which influence is vertically effective within the organization.

I agree with Professor Meij's comment that "what is important only is that organization consists in widening and deepening control." However, there is a considerable difference between the "widening" of the span of control of the executive as contrasted to "deepening" it within the hierarchy of the traditional organization theory. At the second level removed from himself, the executive can exercise influence only and not authority, otherwise the intervening level of supervision is redundant. It is the recognition of this fact that accounts for the precept which states that each person in the organization should report to one and only one superior. Thus, following Professor Meij's "deepening" argument to its logical conclusion forces one to admit that the influence of the policy making body is more effective in the "flat" rather than the "peaked" organization. To employ a familiar analogy from physics, the effect of influence is in inverse proportion to the distance, or the number of scalar levels, between the operative employee and the source of policy.

The influence of the peak coordinator according to Professor Meij, and he is arguing in terms of traditional organization theory, should penetrate through every level of the organization. The executives of the organization ". . . must be convinced of the adequacy and rationality of his directives" and "therefore he must take into account the opinion of his group." It was a recognition of this fact, and the research findings of investigators in the behavioral sciences, that led me to the conclusion that policy formation in the institutionalized organization must be the result of group effort. Policy and changes in policy are accepted much more readily if the executives concerned have had an opportunity to participate and discuss them prior to their adoption or change. In the substantively decentralized organization, the peak coordinator is replaced by a policy forming group and the "deepening" of the influence of this supreme coordinating authority is achieved by "taking into account", not only the opinion of this group, but also of the affected operating executives.

I further agree with Professor Meij that "both centralization and decentralization are features of the outer structure of management." I would go a step farther and say that the survival and growth of the successful large organization are predicated in the inner structure on the centralization of policy and the decentralization of operations. The fact that policy is developed at the hub of the organization requires that it be general in nature—that it define the broad objectives and the constraints within which the decentralized divisions carry out their operations. It is important to note that this definition does not depend on a policy-administration dichotomy but rather the opposite.

Figure 1 illustrates how policy is developed within the substantively decentralized organization. The division managers, along with the board of directors, constitute the policy forming group. The fact that the operating executives contribute to policy means that the goals of the organization are realistic and acceptable to the line. In Sears Roebuck and Company, for example, each territorial officer is a member of the board and takes part in the formulation of policy ". . . which is hammered out slowly by a process of continuous compromise which may not fully satisfy anyone but which seldom deeply dissatisfies anyone."[1]

[1] *Boris Emmet and John E. Jeuck*, Catalogues and Counters: A History of Sears Roebuck and Company, *(Chicago: The University of Chicago Press*, 1950*)*, *p.* 367.

A chief executive is necessary in the substantively decentralized organization but policy decisions are the result of group effort. The peak coordinator's role is not that of final decision except in rare instances but rather that of developing a management team which will participate in the coordinating function today as well as insuring a continuity of policy in the future. The following suggests how the chief executive contributes to the success of the organization:

> *Today in medium and large-scale enterprises a team corresponds to the entrepreneur of theory, i.e., men with particular, often very specialized, and very different capabilities run the enterprise. . . . In countries in which capitalism is 100 or 200 years old, men with such and similar capacities are abundantly available and often the only function of the chief executive is to bring them together and make them cooperate. . . . In many cases the difference in collective capacity makes for profit or loss, or for more or less profit in the competitive struggle. Or, to put it differently, the earning capacity of a team may be much higher than the earning capacity and consequently the market value of each member. This fact explains in part how genuine profits . . . may originate in largescale organizations without any exploitations whatsoever.*[2]

Under substantive decentralization the source of authority is the organization rather than the person of the peak coordinator. Participants are the source of knowledge and discussion is the method of arriving at major decisions. Policy formation in the institutionalized organization is a carefully defined process based on survival and growth over a very long planning horizon. In effect, "deepening" of the span of control of the supreme coordinating authority takes place as the policy constraints become clearer to those concerned with operations. In other words, "a campaign . . . cannot be directed by a 'debating society'; and many other kinds of action also require a single and absolute general. But for the purpose now in hand—that of preventing hasty action, and ensuring elaborate consideration—there is no device like a polity of discussion."[3] Beyond this, ". . . a polity of discussion is the greatest hindrance to the inherited mistake of human nature, to the desire to act promptly, which in a simple age is so excellent, but which in a later and complex time leads to so much evil."[4]

Policy, as has been indicated in an earlier paper in this series, is to the organization what culture is to a society.[5] In Figure 2, the area within the dotted line constitutes the general value system, or policy, of the organization, arrived at by a "polity of discussion." To put it another way, the centrally developed policy is the sole constraint under which operations are conducted. The following forcefully contrasts the hierarchy of traditional organization theory with the system of substantive decentralization where decisions are made at levels of the organization often far removed from the supreme coordinating authority.

> *Rigid organization and procedure inevitably give rise to dilemmas. For instance, an imposed rule requires enforcement if it is to have any meaning; enforcement raises the problem of exceptions, each exception granted undermining the authority of its framers; yet the infinite variety of situations in industry inevitably presents exceptional cases. If 'the rules' are altered to permissive rules the dilemma may be avoided. The authority of the situation takes on real force. The autonomy of groups is emphasized; more general controls are instituted as and when the groups recognize their need. Management is concerned with fostering this understanding. In this atmosphere the self-regulative forces can grow and acquire flexibility of priceless value.*[6]

FIGURE 2 shows the operations aspect of the substantively decentralized corporation. It is important to note that in this phase the division stand alone virtually as an independent entity except that it must operate with policy constraints of the home office as indicated by the dotted line. In terms of accounting theory, the division may be said to exist as an independent accounting entity while the home office may be likened to an open-end investment trust.

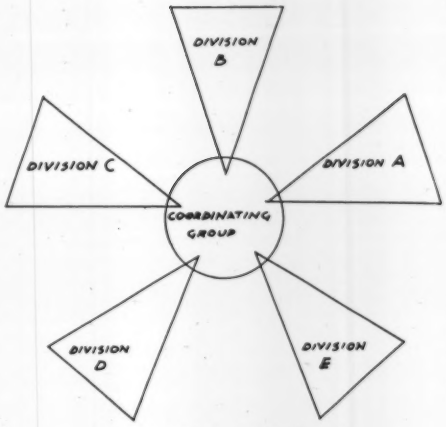

FIG. 1 POLICY FORMATION

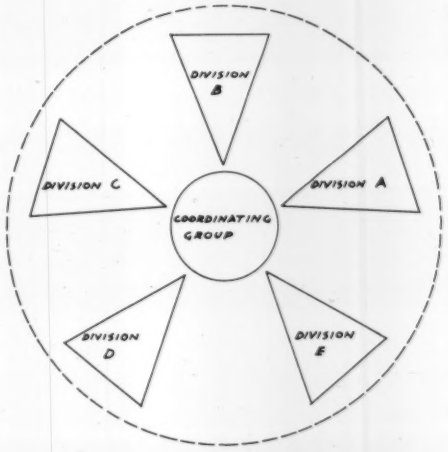

FIG. 2 OPERATIONS

Transactions that affect the division are considered to be those of a completely separate organization. Thus, if a sale is made to another division of the same corporation, the transfer is made at the competitive, market price rather than at cost as is the case in the hierarchically organized firm. Where competitive prices are not available, bargaining is used to arrive at mutually satisfactory prices ". . . in the expectation that the selfish interest of each divisional management will provide realistic transfer prices.[7]

In connection with the degree to which substantive decentralization prevails within the Ford Motor Company at the present time, the following is pertinent.

> *The manager of each profit center should have the responsibility and necessary authority to operate his division as a separate business, subject only to general guidance from broad company policies and, on criti-*

[2] *Fritz Redlich, "The Construction of a New Theory of Profit: A Criticism,"* Explorations in Entrepreneurial History, *May* 15, 1952, *pp.* 207-208.

[3] *Walter Bagehot,* Physics and Politics, *(New York: D. Appleton and Co.,* 1876*), p.* 192.

[4] Ibid., *p.* 193.

[5] Advanced Management, *September,* 1956, *p.* 17.

[6] *Jerome F. Scott and R. P. Lynton,* Three Studies in Management, *(London: Routledge and Kegan Paul,* 1952*), p.* 164.

[7] *E. B. Richard, "A Study in Decentralization: Controllership in a Divisional Organization,"* Bulletin of the National Association of Cost Accountants; *January,* 1950, *p.* 571. *This is a study of the control process in the Ford Motor Company.*

cal decisions, review by top management. Some of the advantages of such decentralization are fairly obvious: It increases the proportion of important executives charged directly with the responsibility for making a profit; it reduces in size and complexity the profit-making unit; and it brings the profit-seeking management closer to actual operations. Not quite so obvious are the incentives to economize in the use of assets and the stimulus to seek additional sources of revenue.[8]

IT IS EVIDENT that the effect of using the price mechanism to supplement hierarchy in the decision making process is to "widen" the span of control of the supreme coordinating authority. Each division stands on its own feet, earns its keep, and has to prove to top management that it is worthy of survival. Top management uses a "measure of performance" to evaluate the efficiency of the operations of the divisions. Central management may suggest but it can not order, except in the case of critical decisions, for to do so would mean that the measure of performance would no longer be an objective criterion of the operating efficiency of the division.

As indicated above, the management of the division must have authority commensurate with its responsibility if it is to do the best possible job. Assume, for instance, that the budgeted measure of performance for a certain division calls for a twenty per cent rate of return on home office equity. If the division has a net return of this amount or more during the relevant period, then its performance has been satisfactory. It is important to note that top management would not have been able to hold the divisional management responsible for operating results without also having given it free rein, within policy constraints, for making the required operating decisions.

The "widening" of the span of control occurs because top management does not review each decision made at the operating level but rather reviews the results of a period of time. Instead of passing judgment of decisions *a, b, c, . . . n* individually, the home or group office is interested only in the aggregate result of decisions $a, b, c = n$. Widening of the span of control has quite obviously taken place — it is much simpler to review an operating statement and a balance sheet once each month or quarter than it is to pass judgment on the myriad of decisions or transactions that ended up showing a $200,000 net profit on a home office equity of $1,000,000. A corollary of this process is quite clear; where the home office is presented with a lesser amount of "exceptions," there is less undermining of its influence.

An interesting example of a substantively decentralized firm occurs in the marketing organization of the General Petroleum Corporation.[9] As a result of the decentralization of its marketing operation "men, of assistant division manager caliber were assigned to the district managerships. . . . Under each one are 12 or 13 men; previously district managers had 5 or 6 on their staffs."[10] Even more was the effect that substantive decentralization had on the composition and the location of the decision making function. The results of the reorganization are summarized in Table 1.

According to Table 1, the span of executive control of the Board of Directors of this corporation was fifteen times wider after decentralization than before. Similarly, the span of executive control of Home Office executives became four times wider. Especially worthy of note is the increase in the scope of responsibility of the position of District Manager. Each of these job classifications now calls for nearly seven times as many decisions as previously and the supervision of more than twice as many people.

The question immediately arises as to what made these radical changes in the nature of the decision making function possible. Not only is the span of control of the district manager considerably wider than it was before reorganization; the influence of the supreme coordinating authority, in this case the Board of Directors, was also deepened by eliminating two levels of management.[11] Now, "each district and division office receives profit and loss statements monthly, so the managers can see how their operations are going. At one time, these statements were pretty much restricted to the home office, so field offices were unable to keep a close check on area operations. GP expects to develop controls even further because top management's responsibility for the success of decentralization is heightened by the increased delegation of authority."[12]

ANOTHER and equally important feature of substantive decentralization employed by General Petroleum is "area selling." Each salesman handles all the products of the company in his territory without any overlap. As a result, "salesmen concentrate on good profit prospects and, within the concept of providing good coverage, limit the time spent on marginal accounts."[13] Thus the idea of the independent accounting entity and the use of the price mechanism as control devices are carried down, not only to the level of the division and the district, but, to the level of the individual salesman and his territory.

As Yntema points out above, the fact that the quantitative revenue and cost data are developed at the very lowest level of the organization makes it possible to translate them into economic terms. Once this has been done the marginal analysis may be used to evaluate

TABLE 1

Locus of Decision Making per 1,000 Propositions Before and After Decentralization in the General Petroleum Corporation

Decision Making Unit	*Before Decentralization*		*After Decentralization*	
	Number of	*Per Cent of*	*Number of*	*Per Cent of*
Board of Directors	150	15.0	10	1.0
Home Office	600	60.0	150	15.0
Division Manager	150	15.0	150	15.0
District Manager	100	10.0	690	69.0
Total	1000	100.0	1000	100.0

Source: *Ibid*, p. 24

[8] T. O. Yntema, "*Establishing More Effective Management Controls*," Management Review, *October*, 1954, *p.* 683.

[9] "*Decentralization—Key to Better Marketing*," National Petroleum News, *February* 24, 1954, *pp.* 20-27.

[10] Ibid., *p.* 24.

[11] Ibid., *p.* 22.

[12] Ibid., *pp.* 22-23.

[13] Ibid., *p.* 23.

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alternative propositions. This is a decision making advantage that is not available to the purely hierarchical organization which must continue to rely on the review and analysis of individual decisions through an increasingly complex network of executive levels. In view of this advantage of substantive decentralization, it is extremely significant that "excellently managed" American corporations are making increasing use of "direct costing" at the operating levels of their organizations.[14]

THE FIRMS that Earley studied were similar to the General Petroleum Corporation in both management philosophy and organization structure. In his own words:

> *Proper organization and procedures are considered important for securing marginal data and using them effectively. Three such aspects of organization were inquired into: the administrative and technical differentiation of activity by products and market areas; management reports of variable fixed cost breakdowns by segments; and the participation of different enterprise functions in planning and decision-making.*[15]

In sum, I find myself in both agreement and disagreement with Professor Meij. I agree with him that span of control limitations are present in the traditional hierarchy of organization theory. I also agree that a theory of organization can be developed by using the span of control limitation as a jumping off point. However, it has been my observation, confirmed by a study of many organizations, that the span of control limitations of the Graicunas-Davis hypothesis are far too narrow. This point of view was developed at length in my paper, "The Span of Control—Fact or Fable," and to repeat what appears there is hardly necessary.

Furthermore, a theory of management need not rest, as I have tried to explain above, on hierarchy alone. The introduction of the price mechanism, of voting, and of bargaining into the decision making structure of the organization operates so well as to make some of our large corporations, *e.g.*, General Motors, *too* efficient.[16] In this same connection, it is interesting to note that many activities of the U. S. Department of Defense have adopted price mechanism devices such as industrial, stock, and management funds in order to do a better job of resource management. As a part of this approach they have deliberately fostered ". . . the dangers of competition within the concern itself."[17]

I do not agree with Professor Meij that "splitting up" a growing business into a series of independent units can never give a satisfactory answer to the management problem.[18] In my opinion, competition among groups and divisions of the substantively organized corporation is good for it and good for the society. In a sense, the diversified, substantively decentralized, multi-product firm introduces a progressiveness into the economy that is lacking in the oligopolistic industry of economic theory. Furthermore, the continuous improvement of electronic data processing systems will undoubtedly accelerate the trend toward substantive decentralization. The increased use of these systems will enable top management to do even more "splitting up" in order to test executives in commands of their own while at the same time speeding up the control processes. This, in turn, will permit top management to intervene in those exceptional cases where ill-conceived decisions at the operating level may endanger the survival of the entire organization.[19]

In conclusion I should like to point out that when the theory says something can not work while it actually does work in practice, then a new theory is needed. The theory of substantive decentralization is an attempt in this direction. Like all theories, it must be modified as the real world changes and as our knowledge about organizations increases. Span of control limitations still apply to the pure hierarchy of traditional organization theory but new decision making processes have been added which act both to "widen" and "deepen" the area over which a coordinating center can exercise control. ■

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[14] *James S. Earley, "Marginal Policies of 'Excellently Managed' Companies,"* American Economic Review, *XLVI (March,* 1956*)*, 44-70.

[15] Ibid., *p.* 48.

[16] *See "Profit Margins at General Motors: A Background Study of Management Action," American Institute of Management, The Corporate Director, July,* 1956. *This study states that "the economic law of diminishing returns that was supposed to hold bigness in check was promulgated before GM management proved what skilled management could do with bigness." (p.* 4*).*

[17] *J. L. Meij, "Some Fundamental Principles of a General Theory of Management,"* Journal of Industrial Economics, IV *(October,* 1955*)*, 22.

[18] Ibid., *p.* 22.

[19] *I am indebted to my colleague, Professor Eugene W. Burgess, for some of the above thoughts on the relation of electronic data processing to increased employment of substantive decentralization.*

B. E. GOETZ

After faculty appointments at the University of Chicago School of Business, the University of Buffalo, Illinois Institute of Technology and American University (Washington, D. C.), Professor Goetz became Professor of Business Administration at Antioch in 1945, where he remained until 1954 when he went to M.I.T. He has been a member of the staff of James O. McKinsey Company, Chicago, and since 1935 has been associated with Sessions Engineering Company. He is a Past President of the Society for Advancement of Management's Chicago and Dayton Chapters and Secretary-Treasurer of the Academy of Management. He is the author of *Management Planning and Control*.

Mathematical Models Of Management Significance

by B. E. Goetz

Professor of Industrial Management
M.I.T. School of Industrial Management
Chicago

MY ARTICLE on "The Last Twenty Years in Management," published in the March 1956 issue of *Advanced Management*, ended with an assertion that management had entered upon a second "scientific revolution" characterized by a mathematical-statistical approach to problem solving and decision making. This article is an elaboration of that theme.

Problem solving in physics has long taken the form of a search for mathematical models (and more recently for statistical models) which describe and predict physical phenomena. In effect, the physicist observes inputs and constructs models to predict outputs. The more rational branches of engineering reverse this process. The engineer begins with the desired outputs, and uses the physicists' models to predict the inputs necessary to achieve the stipulated outputs.

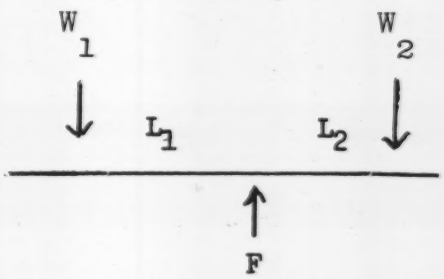
The current breakthrough towards a more scientific management tends to take the form of a search for mathematical models that will predict accurately the consequences or outputs which follow observed inputs, followed by manipulation to determine what inputs must be fed into a situation to produce the most desirable configuration of outputs. This article is on the nature, sources, and uses of mathematical models of managerial significance. I hasten to add that however mathematical some of the models now in use or contemplated may be, this article is not very mathematical!

The models discussed in this article are abstractions. The significant aspects of a situation are abstracted and incorporated in a model to facilitate experimentation, problem solving, and decision making. Experimenting on a model may be faster, cheaper, simpler, and/or more productive than experimenting by attempting to manipulate the whole of complex managerial situations.

There are a good many physical models. Aerodynamic design may be tested on model planes mounted in a wind tunnel—shape and surface are the important abstractions; weight and what's on the inside are ignored. A structural steel bridge member may be simulated in transparent plastic in order to study internal strains by observing color patterns made by transmitted polarized light. A river valley may be represented by a mud basin in order to study currents, erosion, and silting problems.

There are a good many pictorial models. A topographic map and derived graphical cross sections may be used to study the location of a railroad or a dam. An engineer's blueprint is a pictorial model used to communicate instructions to a manufacturing department concerning the shape and size of an object to be produced.

Finally, there are mathematical models. I could conceivably use a teeter-totter (a physical model) to investigate a problem concerning a beam in a bridge or a building. Or I could draw a simple diagram (a pictorial model) to investigate the same problem:



where W_1 at distance L_1 from F is balanced by W_2 at distance L_2. Or I can use a mathematical model:

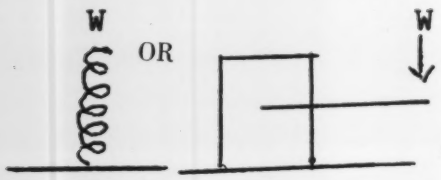
$$W_1 \times L_1 = W_2 \times L_2$$

$$\text{or } W_1 = \frac{L_2}{L_1} \times W_2$$

$$\text{or } W_1 = KW_2$$

Similarly, I can load a spring in a laboratory to get a physical model representing a problem situation, say designing the springing of a railroad freight car. Or I can draw a pictorial

model to represent the situation:



Or I can capture an essential element of the situation in a mathematical model: Displacement = a constant multiplied by the load; D = KW where K depends upon the material, size, and shape of the spring, and the displacement is proportional to the load imposed.

There are a good many such mathematical models representing physical situations, e.g.:

(a) Current flowing through a resistance is proportional to the electrical pressure applied: E volts = I amperes x R ohms.

(b) Acceleration is proportional to force and inversely proportional to mass: F dynes = M grams x A centimeters per second per second.

(c) The laws of gases:

$V_1P_1 = V_2P_2$ and $V_1/T_1 = V_2/T_2$

Volume is proportional to temperature and inversely proportional to pressure.

Such models are usually "true" (i. e., are good predictors) only within limits. Mathematical models should not be strained too far. Too much weight and the spring breaks. Too much current and the wire melts. Pack gas molecules closely enough by high pressure and low temperature and Van Der Waal's correction to Boyle's and Charles' mathematical models becomes necessary. But within appropriate limits, the mathematical models formulated by physicists and used by engineers are good models. Care and restraint are needed when a situation requires extrapolation beyond the limits within which the model has been tested.

IN SPITE of the diversity of physical situations represented by the models presented above, these particular models are mathematically identical. All are of the form a = b x c. This means that to the extent that they are good models, the situations they represent can be manipulated to predict one another's behavior; and this is the principle of the analog computer. By designing a proper electrical circuit, with a resistance in ohms set equal to the constant of the spring, or to the mass being accelerated, or to the ratio of the lever arms of the teeter-totter, we create an electronic analog computer. As we change input voltages imposed on the resistance to correspond with changes in the weight on the spring, or of the force used to accelerate, or in the weight on one arm of the teeter-totter, an ammeter measuring the electrical output of our analog circuit gives us solutions to the physical problems represented by our mathematical models. We can avoid the bother of interpretation by calibrating our voltmeter in appropriate input units, and our ammeter in the units in which outputs of our physical system are measured and thus make our electrical analog into a "direct reading" computer.

Given a variable physical situation, we find a mathematical model which predicts its behavior. Then we design a convenient model, usually an electrical analog, which can be accurately represented by the same mathematical model, and we manipulate the analog to get the answers to our original problem. Electrical analogs are swift, precise, and easily manipulated. We can make measurements of variable factors in a physical or social situation, feed these data into our electrical analog as appropriate inputs, and get answers (as measured outputs) to its mathematical model which was selected as identical with the mathematical model of the physical or social problem situation. Thus with radar and the other perceptors we can feed information concerning location, speed and direction of an enemy aircraft, and wind velocity, barometric pressure, and whatnot into an electrical computer which calculates the distance, direction and necessary lead, and delivers its answers by pointing and discharging an anti-aircraft gun, all in a matter of seconds.

So much for what a model is. Now, where do they come from? How are they constructed? We investigate any phenomena about which we are curious. We measure all input and output factors which seem at all likely to be significant. We tabulate our results. We also do some tall and deep thinking. By rational derivation, by application of dimensional theory, by intuitive insight, or by fumbling with our tabulated data, we formulate a mathematical model that seems to represent the situation. Since an infinite number of models are possible and almost all are likely to be poor predictors, it will generally pay off in increased speed and decreased cost to do enough thinking to select highly plausible models. Dimensional analysis, for example, may suggest factors and powers needed to state the two sides of an equation in comparable units. Thus if the output side is measured in foot-pounds per second, the input items will have to be measured, multiplied, and divided to give foot-pounds per second. Terms to be added should be stated in comparable dimensions. Coefficients may have to be introduced to make days comparable with years or centimeters with inches. In any event, by hook or crook or tour de force, we produce one or more mathematical models which appear likely to be good representatives, good predictors, of the physical, biological, social, or economic phenomena under study.

OUR model is likely to be well studded with constants that require evaluation. We call on our statisticians to fit our model to our observations by the method of least squares. By the technique of partial differentiation, they can find the constants which will minimize the sum of the squares of the differences between calculated and observed outputs.

Now, using our model(s) on tens, or hundreds, or thousands of new sets of measurements of input factors, we calculate the corresponding outputs which our model(s) tells us to expect. We compare these calculated outputs with the corresponding measurements of outputs, and thus check the accuracy of the predictions of our mathematical model(s). If we have more than one model, we should now be able to choose the most reliable predictor.

Since there are limits to the accuracies of our measurements of both inputs and outputs, we cannot expect prediction and event to coincide precisely. But if the discrepancies are small and are distributed essentially in the pattern of the normal probability curve, we will have confidence in our model. We even measure the degree of confidence by calculating the correlation coefficient. If our mathematical model involves a number of constants, it will be better to calculate the "coefficient of confidence" which introduces an adjustment for the number of "degrees of freedom."

With all this care, we may still stumble into a "spurious correlation." If we construct a mathematical model to predict the white population of North America from measurements of the girth of a redwood tree which sprouted in 1492, we would get a model which showed a history of more than 450

years of accurate prediction. After all, both series follow growth curves, and by plotting years on the x-axis and putting redwood girth and white population of North America on appropriate scales on the y-axis our two curves would approximately coincide. Thus we see that it is worth while to have rational support for empirically derived mathematical models.

Again, a model may seem so successful that we use it as a definition. If we define and establish measuring techniques to ascertain mass and acceleration, we can define "force" by the equation F = M x A. Then if we construct an instrument to measure forces, and calibrate our instrument by means of our definition, our instrument must report our mathematical model a good predictor! And the more exact our measurements, the more precisely "true" our mathematical model will seem to be.

PHYSICS and engineering grew great by manipulating their variables in the laboratory. By and large, the traditional approach has been to freeze all factors but two—one input and one output factor. Then by varying one, changes are "caused" in the other. Both are concurrently and repeatedly measured over the widest practicable range, and a mathematical relationship sought by the process described above. Often it takes great ingenuity, brilliant technique, and endless patience to identify all of the significant input and output factors, to hold all but two precisely constant, and to measure the varying input and output factors precisely and concurrently. If many factors are involved, it takes a great deal of time and patience to run down the relationships between each pair over the entire desired range of variations for every possible combination of factors taken two at a time. Even then, there may be cross relationships which will take more years of carefully controlled experiments to ferret out and to reflect in the mathematical model. It took F. W. Taylor 20 years and a carload of steel to work out the influences of his 12 variables on the speed of cutting metals!

Some phenomena cannot be manipulated, and the traditional scientific laboratory experimental technique fails completely — it is simply inapplicable. This is notably true of astronomy and economics. The astronomer lets nature perform experiments for him. He lets her vary the factors—what else can he do? But he measures and correlates and ultimately comes up with mathematical models that are highly successful in predicting eclipses, tides, and the positions and motions of stars and planets (i. e., the angles and speeds at which to set his telescope in order to photograph a particular star or planet).

Management problems, e. g., those of a sales manager or of a factory superintendent, are something else again. Usually there are many factors, many of which cannot be standardized, held constant, or controlled. Many are peculiarly difficult to measure. However, if we hope to be scientific, measure we must!

Some factors may be subject to standardization—but beware, we may throw the baby out with the bathwater. We must vary, or allow to vary, every important factor we seek to investigate. We may somewhat simplify our problem if we hold constant those factors which we propose to standardize in our operations. (Is such standardization possible? Will it prove too expensive to be desirable?) We may get rid of others by randomizing. If we cannot control our raw materials under operating conditions, we can eliminate variations between batches in our experiment by mixing batches from all sources in the proportions in which they are obtained from these sources. Running such mixed raw materials into our processes or into our experiments randomizes this variable and thus cancels it out of our results allowing us to investigate the effects of other variables. Of course, if variations in raw materials are significant and controllable, such randomizing would precisely be throwing away the baby with the bathwater. Moreover, randomizing may be almost as difficult as controlling and standardizing, or as varying in a measured manner.

Significant variables which can be measured, and controlled by selection or manipulation can be disentangled and their separate contributions to output determined by the techniques of multiple correlation. As the number of variables to be investigated increases, the number of observations needed and the arithmetic required increases rather sharply. Both, however, remain far below what would be required to investigate the same number of variables by the old, one-at-a-time technique. Assume six input variables seem to affect output in a significant degree. Two are susceptible to standardization and continuous control without crippling our operations, and without excessive cost; indeed, such standardization often results in a sharp cost reduction. These, then, we freeze, much as did the physicist or the engineer their variables in their laboratories. Two are significant, but cannot be controlled under operating conditions, so we carefully randomize them, remembering that virtually no carelessly selected items are truly random. The other two we cause to vary simultaneously over their entire ranges, independently, so X will be both high and low and middling when Y is low, and also when Y is high, and when Y is middling.

If the two are truly independent, our mathematical model will contain two separate terms, for example:

$$\text{Result} = aX + bY \quad \text{or}$$

$$aX^2 + bY \quad \text{or} \quad \frac{a}{X} + bY$$

If they are not independent, the problem tends to be more complicated and the model may look like one of the following:

$$\text{Result} = aXY \quad \text{or} \quad aX + bXY$$

$$\text{or } aX^y \quad \text{or} \quad \frac{aX}{Y}$$

or even more complicated combinations. In any event, one or more such models can be selected for trial and evaluation. Then the constants are determined by the technique of fitting the model to the data by "least squares." The success of the model can be numerically measured by matching predictions with corresponding measurements of outputs, and computation of correlation coefficient or of the coefficient of confidence. Whenever a model proves unsatisfactory, another relationship can be tried or new significant factors sought and included. It may take years of patient research, but if the researcher is clever, and patient, and skillful—and lucky!—he ultimately comes out with a mathematical model which predicts reasonably well (no one has yet devised a good model to predict stock market prices).

Now that we have a model which does predict, we can emulate the engineer and work it backward. We can feed in the result which we would like it to predict and calculate the values of the variable which will produce this result. Having determined what values of the variables are associated with the desired result, management gives orders, offers inducements, and follows up subsequent action to see that these values are indeed fed in, and if the mathematical model continues to be a good predictor, the results should be satisfactory.

Often the manager seeks the best possible results without knowing precisely what are the best possible results. In such an event, the prediction model is differentiated (calculus) and the result is set equal to zero, and the resulting equation solved for the values of the input variables which will produce the desired optimum result, be it maximum profit or minimum cost. Then, as before, management gives orders and inducements which result in feeding these calculated inputs into operations.

Now, as a specific and familiar illustration, consider the problem of the economic lot size. To keep it simple, assume a constant rate of withdrawal from inventory, and that production is in batches which move into inventory as unbroken lots. Note that we have excluded continuous-process industries, and industries characterized by cyclical variations in output, and industries producing batches determined by customers' orders for special products.

Now, we study the situation and divide the costs of production into four component groups:

(1) Fixed costs which are not affected within the ranges under study by either changes in the total number of units produced or by changes in the number of batches put through the plant, e. g., real estate taxes.

(2) Variable costs which increase or decrease in proportion to the total number of units produced, e. g., cost of raw materials.

(3) Variable costs which increase or decrease in proportion to the number of batches put through the plant, e. g., costs of writing shop orders.

(4) Variable costs which increase or decrease in proportion to the average investment in inventory, e. g., insurance on goods in stock.

If U equals variable costs per unit, and Q equals number of units per period, (2) will equal U x Q. If L equals the number of units in a lot (the variable to be controlled to minimize total costs), then Q/L equals the number of batches, and if S equals variable costs per batch, (3) will equal S x Q/L. Average inventory will equal L/2, its value for this problem will be U x L/2; and if C equals variable costs of carrying inventory, (4) will equal U x C x L/2.

Finally, total cost will equal (1) plus (2) plus (3) plus (4) or

$$T = F + U x Q + S x Q/L + U x C x L/2$$

which is our mathematical model for predicting total costs. If our analysis is correct, we do not have to fit this model to our data by least squares in order to determine constants. However, we should test the model for its accuracy in predicting total costs, and surely this has seldom, if ever, been done. The difficulty seems to be in measuring each item independently in order to compare measured total costs with calculated total costs in order to calculate a coefficient of confidence.

If we are satisfied that our assumptions—constant usage, etc.—are valid, that our model is an effective predictor, and that we know how to measure the input and output factors (i.e., find number values for the symbols used), we can proceed to find the value for L which minimized T. First, we differentiate (here's that calculus step again) T with respect to L. Since F and U x Q are independent of L, they drop out, and we have:

$$dT/dL = - S x Q/L^2 + U x C/2$$

Setting this equal to zero and solving for L, we have:

$$L = \sqrt{\frac{2 x S x Q}{U x C}}$$

Five final cautions:

1. Our assumptions are valid in only a few real situations.
2. Our model has not been properly tested.
3. We don't really know much about measuring the quantities for which the symbols stand. Conventional cost accounting certainly doesn't do it.
4. We must be careful about extrapolating into ranges outside of the experience upon which our model is based, e. g., if all past batches ranged from 10 to 100 units and our formula indicated L = 1000, we are engaged in a dangerous extrapolation.
5. Our whole approach assumed that each item, and each batch, was independent of each other item and batch. Often, due to scheduling interferences, or limited stockroom facilities, or financial limitations, this will not be true; and the equations for different items will be cross-linked, and will require simultaneous determination within whatever overall limits exist. ■

Suggested further reading:

Bross: Design for Decision, *MacMillan*, 1953, *especially Chapter* 10.

Ackoff: Design for Social Research, *U. of Chicago Press*, 1953.

Whitin: Theory of Inventory Management, *Princeton University Press*, 1953.

Goetz: Management Planning and Control, *McGraw-Hill*, 1949, *esp. pp.* 206-212.

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Upon graduation from Harvard in 1942 with an A.B., Mr. Spence went into the Coast Guard where he served until 1946, when he became a political reporter and columnist for the Schenectady *Union-Star*. In 1948 he left the *Union-Star* to become a writer and mid-western correspondent for *Time* Magazine. He remained with that publication until 1951 when he was made Assistant to the Director of the Ford Foundation's Division of Mass Communications. Mr. Spence founded his own company in 1953, an organization of Business Editors and Communications Consultants.

LEWIS H. SPENCE

Dollars And Sense Of Employee Communications

by Lewis H. Spence

Lewis Spence & Company
Cranbury, New Jersey

RECENTLY a bombshell was set off under management's seat, but hardly an executive blinked. In an article summarizing the results of a study of "fringe" benefits (i.e., employee pension plans, health and hospital insurance, vacation pay, etc.), Austin M. Fisher and John F. Chapman wrote: "Most of the respondents (executives replying to the survey) believe that their companies are doing a fair job merchandising their fringe programs to employees. Yet more than 80% reported that their employees do not know how much money the company is spending on its fringe benefit program."

"Big Costs of Little Fringes"—HARVARD BUSINESS REVIEW.

For a business community that prides itself on its selling and advertising know-how, this is an appalling admission. But more important than its guileless confession of inadequacy is the dangerous complacency it reveals. For a generation businessmen, great and small, have been talking of the mortal perils of "creeping socialism". Yet in this simple statistic there is good evidence that they unwittingly invite it.

In the next ten to twenty years the American economy, by all informed estimates, faces a social revolution certainly as great if not greater than the one we have witnessed in the recent past. With our expanding technology, the introduction of automation, a continually rising standard of living, immense social upheavals are bound to occur. Traditionally our revolutions are bloodless. But the challenge remains whether our present economic system can survive the change with its dynamic qualities of freedom unimpaired.

The recent growth of industrial communications is one of the strange marvels of present day business. In the past ten years employee publications, for instance, have multiplied until currently the titles of 5,700 are listed with *Printer's Ink* alone. Circulation is variously estimated at between 60 and 70 millions.

To seek a definition of the aims of employee communications is like asking for bread and being given cake. It should restore management "leadership" we are told, or re-affirm the "American Way of Life". Since the advent of sociologists and psychologists on the business scene, communications have become a "science", improving employee morale, stimulating the "interchange of ideas", creating a "sense of belonging". Seldom, and then invariably in a guilty undertone, does one come across a truly businesslike answer; that is, to produce a profit.

Jacques Barzun, that acute observer of American life and history, has pointed out that our "romance with practicality", as he puts it, is the chief explanation of America's incredible growth and success. From it stems our sense of equality and tolerance, our ability to adapt to every changing situation. As nowhere else practicality has found its home in the business world. But the American belief in the profit system is far more than a superficial rationalization of the "acquisitive" instinct, as the socialists like to say. Quite the contrary, rooted in the profit system is the philosophical conviction of William James' pragmatism: that the competition of the market-place in the long run is the best test of goodness and worth. In sum, according to our own creed, communications has no place in the business community unless it can produce a practical result; namely, hard cash profits.

The fallacy of the "sweetness and light" approach to communications, which is responsible for the endless reams of plant chitchat, inspirational messages on the "American system" and other such nonsense, is no place more glaringly revealed than in this conception of human relations. The fact that employees are people makes them so winningly susceptible to the blandishments of the profit system. And unless we recognize these human qualities, we relegate the employee to an abstraction more cruel than any estimate of his commodity value. Furthermore, the future of the American system and the

vast progress it has brought may well depend on management's success in translating the social benefits of the profit system into balance sheet statistics.

BUT HOW, the business executive may ask, can this be done? In what way have his present efforts gone wrong?

Writing recently in *Fortune*, Charles P. Taft had this to say: "The real threat of creeping socialism does not derive from government-sponsored welfare programs . . . (it) comes from the general ignorance of economics and the exploitation of this by certain labor leaders, politicians and others."

Like one of the words the advertisers coin for a new automatic gear-shift, the term *economics* has become so obscure over the years that we are rendered inarticulate by it. Yet behind all the shibboleth and cant of economics lies the simple pay check, the new refrigerator, the ranch house with the picture window.

In its efforts to educate the employee to the principles of the American system, management has tended to confuse the textbook with the pay check. As a result it is no wonder that the employee remains ignorant and comes to suspect that his boss knows little more than he. Furthermore, he is not too far wrong in this suspicion, for of the executives replying to the Fisher-Chapman study of fringe benefits a large majority confessed that they themselves did not know how much money was being spent by their companies on the programs.

Education works on principles not too different from the profit system. In order to be taught people have to be shown what is "in it" for them. In other words, education must have something to sell and that something must have personal value. Similarly, even the teacher must have a selfish stake in the rewards. Startling as it may seem, labor and management today share an almost perfect teacher-pupil relationship, for each has something extremely profitable —namely, security and personal welfare—to gain from the other. The difficulty lies in overcoming their mutual blindness to where exactly the profit lies and then in discovering the right "sales pitch."

What is the profit that business is bargaining for in its human resources? No question is more easy to answer. It is a return on business' gigantic investment in employee training, security, health, education and so forth.

But this is only part of the picture. Before a man receives a penny of benefits, he first must be hired—a cost that the Rockwell Manufacturing Company, for example, puts at $275 for a salaried employee. Next comes training, and finally there is the simple bookkeeping expense of maintaining a man on the payroll. All these costs are over and above wages and salary, but it would be conservative at best to estimate them at 25% of the gross payroll of industry.

These statistics point to a conclusion that management has been dangerously slow in comprehending. It is that business' greatest single expense and investment lies in human beings. Yet what is it spending on merchandising this investment? The paltry $200 million or so a year budgeted to communications, compared to the $37 billions plowed back into capital goods, or the $7 billions spent on advertising.

The results of this policy are appallingly revealed in the Fisher-Chapman study cited above. What the widespread ignorance of industry's investment in employee welfare that this study pointed to is costing in terms of job turn-over, apathy, industrial unrest and even downright antagonism is impossible to estimate. But one thing is sure: it is a dead loss that could be turned into a profit. More important, this loss over the long run, as we shall see, may have disastrous effects for our total economy, and perhaps govern the survival of business as free, competitive enterprise.

The oldest truism of selling is that you can persuade a man to buy the Brooklyn Bridge (or the Acropolis) if you can convince him it is something he cannot do without. No statement could put more clearly management's mission in "selling" its employees on their stake in the profit system. It is literally true that the social benefits they have achieved under capitalism are something they *cannot* do without. Unfortunately, it is the one approach management has neglected.

Study after study has hammered home the lesson that in order to communicate with its employees management must talk on *their* level, in terms of *their* contribution, *their* rewards. This insistence on the "me" in communications does not betray a meanly selfish spirit in employees, but is a perfectly natural human response. Only the genius or the dreamer is interested in the dark side of the moon. Yet it is about the figuratively dark side of the moon that management has consistently been talking. Lacking a thoughtful plan or purpose, it has failed to illustrate the principles of such elementary economic laws as the relationship of productivity to real wages, the causes of inflation or the reasons for capital investment. On the contrary, in explaining itself to employees, business has largely left the employee to puzzle out his part in the picture by some mysterious mental telepathy or process of osmosis. Worst of all, it has obstinately refused to pinpoint the discussion to particulars, i.e., the present indicative, first person plural ("We at Standard Machines do this . . ."). Instead, it has clung to the catchwords of the "system," the "economy," the "national welfare."

THE EFFECTS of this ineptitude are strikingly borne out in conclusions of a study recently conducted, comparing union and company publications. In this review, in which the contents of the leading union publications (e.g., *The CIO News*, *AFL News Reporter*, *The Machinist*, etc.) were weighed against 700 company publications on 26 major economic and legislative questions, the authors had this to say: "Week after week they (the unions) pour out a flood of carefully planned and *well-written* (authors' italics) articles . . . which reflect a solid front on almost every major policy question. . . . But when it (management) has used its private communications media in an attempt to influence national, state and local domestic legislation, it has done the job so awkwardly that its employees have often been left asking 'why' to a lot of questions." Leaving aside the dispute as to the appropriateness of discussing political and legislative matters, we cannot dodge the conclusion that the unions have hit upon a communications formula that has won them 15 million dues-paying members. And the formula? The "breadbasket" (what's in it for *me*) technique, say the authors.

But education is not instilled by formula alone. It requires planning and skill as well.

Hitherto, employee communications have been administered like a vaccine: a few "shots" and the patient is expected to be immune to the ills of discontent for a span of years. A pension plan, for example, is "sold" with *one* booklet, a health insurance program with *one* conference or leaflet. In a

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"Round One: Union vs. Company Publications", Fred C. Foy and Robert Harper— HARVARD BUSINESS REVIEW.

nation where the sustained advertising campaign drums on the customers' ears with the regularity of an auctioneer's chant, such naivete is inexplicable. Does management actually think it can merchandise its benefit programs with a one-shot dose—or to use the language of advertising, a single "spot" or double-page spread?

Repetition is the key to the learning process. We remember information by having it dinned into our ears. This is particularly true today when the competition for the audience is as brisk as in a bargain basement. In its employee communications management is entering the market-place of ideas. Consequently, to be heard it must talk loudly and often. But this demands planning—a carefully worked out, long-range program, hitting first this subject, be it a pension plan or safety campaign, and then that in an endless cycle.

But repetition, to paraphrase the battle-cry of the patriots of 1776, without ingenuity is monotony. And it is on this score that management has floundered woefully. In the publications study cited above, the authors say this about the standards employee communications require: "This important kind of thinking and writing calls for skill beyond the 'picnic and bowling team' kind of writing being done in many employee publications today."

Two hundred years ago Samuel Johnson complained about the plight of the writer. "The notice you have been pleased to take of my labors," he wrote Lord Chesterfield, "had it been early, had been kind; but it has been delayed, till I am indifferent and cannot enjoy it." Is the same fate to overtake business' patronage of the contemporary writer?

STATISTICS and studies show that the industrial editor is one of the most poorly paid, unlistened to and neglected skilled workers in industry today. Yet his potential contribution is vital to the smooth functioning of business and perhaps to its very survival in the future. For he, as no one else can, is able to translate the abstractions of the balance sheet into the concrete particulars of the employee's everyday knowledge and experience.

To this point we have defined the purposes and requirements of a successful employee communications program. It should be directed to the practical end of showing the employee the personal stake he has in the profit system and the benefits it brings him. Furthermore, to strike home, it must be conducted in a sustained, intelligent and forceful manner. But given these elements, what can communications do? What is the cash profit they can yield?

Every advertiser knows that in the long run the success of a product in catching the customers' eye depends on quality. Such is the competitive creed of free enterprise. Therefore, in communications management can expect no silk purse from the sow's ear of bad industrial relations. The degree of employee understanding and loyalty (hence, profits) that management can win through the written and spoken word will bear a direct relation to the actions that go with them. Or as Herrymon Maurer has put it: "A corporate decision to have *no* social policies is actually an economic decision with adverse effects on profits."

But even with this there remains the challenge of the competition and the uncertainty of the future.

Looking ahead to labor's demands over the next 25 years, A. F. of L. President George Meany recently wrote: "Our (labor's) goals as trade-unionists are modest. . . . We seek an ever rising standard of living. . . . If by a better standard of living we mean not only more money but more leisure and a richer cultural life, the answer remains, 'more'." Mr. Meany went on to say that the trade-unions believe in free competition. "The American private-enterprise system, despite some defects," he stated, "has achieved far greater results for wage earners than any other social system in history."

The crucial question that labor's demand for "more" poses is whether the "more" may not kill the goose with the golden egg. If the present rate of a 12% annual increase in fringe benefits continues, for example, it will add between *$20 and $25 billions* to manpower costs over the next ten years. Although this is not an insupportable burden, it will demand a dramatic acceleration of our current 3%-4% annual productivity growth. Failing this, labor will be forced, Messrs. Fisher and Chapman point out, "to accept the fact that fringes alone may consume nearly all, if not all, of labor's share in that growth during the coming decade." Otherwise, fringe benefits may become a virtually bottomless pit into which the whole economy could easily fall."

In this crisis automation has become the magic word. The "push-button factory," the "automatic industry" are looked upon as the cure to all our economic ills. But what is the truth about automation?

Automation, economist Peter Drucker has written "is not gadgeteering, it is not even *engineering* (author's italics); it is a concept of the structure and order of economic life, the design of its basic patterns integrated into a harmonious, balanced and organic whole." In other words, it is a *social* change, demanding a fundamental revision of our ideas on secure employment, labor skills, wage and salary, and as Mr. Drucker puts it, "exceptionally clear thinking about the design and structure of the entire business—its goals, its environment, its resources and its organization."

ALL social revolutions, if they are to be peaceable, require an intelligent, well-informed public, particularly in such a technological shift as automation, where mass bodies of men will have to be located in new jobs, learning new skills and functions. Without such an informed public to understand and appreciate the managerial and marketing changes which automation will dictate, business faces a grave crisis. As Mr. Drucker explains: "To try and build an 'automatic factory' in a business that has not otherwise been 'automated' is like trying to put a 1955 Turbojet aircraft engine into a 1913 Ford Model T. . . . The 'automatic factory' would literally shake the business to pieces."

Both in the demands of labor, then, and the challenge of automation management must meet the primary test of articulateness. This will be more than just a play for immediate profits. Its existence as *free* and *private* enterprise will be at stake. For as experience has shown, whenever labor meets management resistance, it turns to government.

Thus circumstance as well as enlightened self-interest force the executive into the role of educator. In this role his strongest ally is the press—i.e., the journalist, the writer.

Thomas Jefferson wrote that if he were given the choice between doing without a government or a free press, he would not hesitate to do without the former. But where Jefferson was merely speculating on such an eventuality, the decision actually confronts management today. May its choice be as wise as Jefferson's. ■

"The Promise of Automation" — HARPER'S MAGAZINE.

New Management Writing . . .

TRANSFORMATION:

The Story of Modern Puerto Rico by Earl Parker Hanson. Introduction by Chester Bowles. 416 pages. Published by Simon & Schuster Inc., New York.

Puerto Rico has in recent years become famous in the United States as a new American industrial frontier where new factories are now being opened at a rate of some 2½ per week, and throughout the world as a former, "stricken," underdeveloped country, which is accomplishing such wonders in improving life through economic development and social-political changes, that nearly a thousand official observers and visitors from a hundred countries now go to the island every year.

Professor Earl Parker Hanson was associated with Puerto Rico as a planning official twenty years ago, during the days of the island's greatest misery, and has been a close observer of its transformation since those turbulent days. The first half of his book tells the story of Puerto Rico's earlier colonial travail, of the political and social unrest engendered, of the rise of Luis Muñoz Marín as a leader with fresh, new ideas, and of the current program's earliest inception in the minds of Puerto Rico's leaders. The second half deals with specific problems tackled under the new program. Various chapters deal with such things as resources, agriculture, industrialization, culture changes, public health, and the democratic program of aided self-help which sustains the movement and makes it truly one of the Puerto Rican people.

Carefully written, though with affection and enthusiasm for Puerto Rico, exhaustive in its detail, the book brings out the advantages of Puerto Rico's present political status, achieved in 1952, as a self-governing free state of U.S. citizens, voluntarily associated with the United States, though not one of the latter.

The book is recommended as a highly readable, eye-opening introduction to our new industrial frontier, and as detailed orientation for hundreds of U.S. businessmen whose management talents are now directed toward Puerto Rico. In a larger sense, and in view of the world fame that has come to Puerto Rico and Governor Muñoz in recent years, it is recommended as an important exposition of "America's answer to both communism and colonialism."

Antulio Rodriguez
Director of Information
Commonwealth of Puerto Rico
Department of State

LET ERMA DO IT

By David O. Woodbury. Published by Harcourt Brace & Co., 383 Madison Ave., New York City. $5.00.

This is an extremely informative book written by a professional author who, in interesting sequence, develops the story of automation from its very inception up to current developments.

In this respect the author builds a firm foundation in one's mind as to the logical developments that have taken place over the many years and, with these roots, has developed a tree full of informative data which a business executive will find well worth reading.

I am still a little mystified as to the choice of title for the book inasmuch as only two chapters are devoted to this particular development. While the economics are not appraised, of this particular system, the related story does give evidence as to the possibilities of things to come in this particular field of "data automation system".

In short, this unbiased presentation by David O. Woodbury can do a great deal toward furthering the knowledge of any student, business executive or government official interested in a fast moving book on "the full story of automation".

A. N. Seares
Vice President, Remington Rand
Division of Sperry Rand Corporation
New York City

THE ESSENCE OF MANAGEMENT

By Mary Cushing Niles. Orient Longmans, Bombay, India, 1956. 460 pp.

Surely the objective envisioned by the author in writing this book is unique in the literature of management. Here is a work which is not designed, as are most management books, for the student, the practitioner or the teacher of management in the country whose business philosophy, policies and practices constitute its subject matter, but for an audience in a foreign land, differing widely in beliefs, aspirations, customs, activities and needs.

Engaged for a period of sixteen months in management work and lecturing in India, Mrs. Niles found that that country "was undertaking one of the greatest expansions in the world's history, but that relatively little of the management experience of the West was available for Indian appraisal." So she set out to prepare for the Indian audience an exposition not only of the current American management scene, but of its background and evolution; not only of what we have succeeded in achieving, but of how and why we came to do it, and where we are tending. She is concerned as much with philosophy as with practice, with broad social purposes as with managerial principles and techniques.

The scope of such an undertaking might well have appalled a mind less schooled in planning, organization and control than Mrs. Niles'. She fixed her boundaries and adhered to them, omitting such subjects as financial management and controllership, production management, marketing, and labor organization. While these are undoubtedly areas of importance in the expanding economy of India, they are left for others to treat. She dwells on the social aspects of work and of the work group; on motivation and attitudes toward work, accomplishment and reward; on the concepts of authority and responsibility; on the nature and means of communication; on change and resistance to its introduction; on leadership attributes and objectives. She devotes major attention to organization structure and dynamics, including principles, functions and relationships; growth; specialization; co-ordination; the role of committees; co-operation, and control. In addition, she provides specific guides for work improvement, furnishing numerous examples of procedures and of questionnaires employed for this purpose.

The reader is made the beneficiary of the author's wide familiarity with the literature of management, for the book is replete with citations of authority and with extended quotations from leading writers, running the gamut from such classics as Taylor and Fayol to such moderns as Bakke and Drucker. Indeed, in her introduction Mrs. Niles acknowledges her indebtedness to "scores, perhaps hundreds of writers, and hundreds more practitioners." By drawing heavily on them she presents to the reader some of the highlights of the experience and thinking of many authorities on a variety of phases of the complex subject of management. These are never merely insertions, but are interwoven in her

text, forming an integral part of it to clarify and illuminate the points she makes. Through them she brings out causative relationships and evolutionary tendencies, and furnishes examples of successful—and occasionally of ill-conceived—applications. The bibliography contained at the end of the volume, numbering well over a hundred references to books and articles, with brief annotations, constitutes a most useful feature.

The task which Mrs. Niles set herself is a delicate one, requiring sound judgment and discretion. Her approach to it, in the opinion of the reviewer, has been admirable, combining a judicious pride in American ideals and progress with profound respect for the spiritual values and industrial potentialities she found in the Indian culture. She is never didactic, never boastful of American accomplishments, but always conscious of the gap between our goals and our striving. She is careful not to recommend the adoption of specific American practices by India, but confines herself to presentation of purpose and underlying psychology, of ways and of means, pointing out avenues of greatest promise equally with pitfalls to be avoided, but leaving it to the Indian reader to evaluate critically what can be made useful within the cultural pattern of his country at this stage in its program of economic development.

That this book should prove a valuable tool in the struggle for democratic industrial progress in India appears to the Western mind, at least, to admit of no doubt. It would seem also to serve another purpose, namely to help dispel any misconceptions that may exist in India concerning the nature of American business objectives and conduct, and to interpret, as the author states, "the heart and mind and skill in action as shown in the West, particularly in the United States, through the use of management in the pursuit of abundance and growth in social living." By this dual achievement Mrs. Niles has made a signal contribution to international understanding. As a by-product, she has written a book which has much to commend it as a text for the American reader who wishes to orient himself in both the philosophical basis and the technical attainments of management in this country, particularly with respect to organization theory and human relations.

Rita Hilborn Hopf
Formerly Vice President,
Hopf Institute of Management

THE STATESMAN'S YEAR BOOK —1956

Edited by S. H. Steinberg, Ph. D. Published by St. Martin's Press, 103 Park Ave., New York. $8.50. 1600 pages.

A world-wide reference book which contains useful information on over ninety separate national states from Afghanistan to Yugoslavia, from such tiny countries as Andorra and San Marino to the major powers, the U.S.S.R., France, Great Britain, etc. This is the 93rd annual issue of the book.

AMERICAN WORKER'S FACT BOOK

Published by U. S. Dept. of Labor. 1956. 433 pages. $1.50. Order from Government Printing Office, Washington 25.

A volume of background information on labor matters, the first compilation of such comprehensive coverage ever published in the labor field. It is a simplified source of information written in plain language and avoiding technical wording and complicated statistics so as to be useful to the lay reader. It is a book that will be useful to businessmen, labor leaders, editors, students and others interested in vital labor statistics.

LABOR—*Institutions and Economics*

by Alfred Kuhn. Published by Rinehart & Co., 232 Madison Ave., New York 16. 1956. 616 pgs. $6.50.

A new method is used to organize material which is designed to bring out with striking clarity the major purposes and problems of organized labor, and to show the basic significance of recent developments. The first part of the book defines the structure and goals of both management and labor; analyzes in terms of these goals the processes and results of collective bargaining; and discusses the effect of public policy and current legislation on bargaining.

INDUSTRIAL ENGINEERING HANDBOOK

Edited by H. B. Maynard. Published by McGraw-Hill Book Co., Inc. 1956. $17.50.

A comprehensive handbook which seeks to provide engineers and management men with the key to more efficient use of men and machines. Many specialists cover fields in which they are expert, making available to the reader authoritative data, principles, methods, and procedures on every important aspect of industrial engineering.

PSYCHOLOGY IN MANAGEMENT

by Mason Haire. Published by McGraw-Hill Book Co., Inc., New York. 1956. 212 pgs. $4.75

An industrial psychologist looks at human relations in business and discusses behavior that underlies specific industrial problems.

SUPERVISION OF PERSONNEL: HUMAN RELATIONS IN THE MANAGEMENT OF MEN

by John M. Pfiffner. Published by Prentice-Hall, Inc., Englewood Cliffs, N. J. 1956. $5.00

A textbook used by a number of universities in their management courses. The book stresses and shows how to develop a sound basis for obtaining maximum efficiency and effectiveness from every available worker.

HUMAN RELATIONS FOR MANAGEMENT

Edited by Edward C. Bursk, Editor of the Harvard Business Review. Published by Harper & Brothers. New York. $5.00.

Twenty authorities contribute to this collection of practical applications on the conduct of human relations in business, selected from the pages of the *Harvard Business Review.*

ADMINISTRATIVE BEHAVIOR
(2nd edition)

By Herbert A. Simon. Published by the Macmillan Co., New York. $5.00.

A study of decision-making processes in administrative organization.

AGEING IN INDUSTRY

By F. Le Gros Clark and Agnes C. Dunne. Published by Philosophical Library, New York. $7.50.

An inquiry based on figures derived from census reports into the problem of ageing under the conditions of modern industry.